Tuesday, March 6, 2018

Tuesday, March 6 and Wednesday, March 7 sessions will take place at the Hilton McLean Tysons Corner hotel. Sessions on Thursday, March 8 will be held at The MITRE Corporation

Welcome Remarks

- Gen Hawk Carlisle, USAF (Ret), President and CEO, NDIA
- Lt Gen Robert Elder, USAF (Ret), Chair, NDIA Cyber and Emerging Technologies Division International

Keynote Speaker

- Walter O'Brien, Founder, Scorpion Computer Services International Ballroom BC

Panel Session: Decision Support Systems

Moderator: Dr. Robert E. Schmidle, Lt Gen USMC (Ret), Former Deputy Commander, U.S. Cyber Command

- Panelist: Dr. Jim Gump, Johns Hopkins University Applied Physics Lab
- Panelist: Bryan Bartels, Chief, Future Ops, USSTRATCOM Joint Air Component Coordination Element (JACCE)
- Panelist: Dr. Tony Ng, CTO & Solutions Architect, Civil Transportation Solutions, Leidos
- Panelist: Jeffrey Gottschalk, Leader, Cyber Systems and Operations Group, MIT Lincoln Laboratory

Panel Session: Artificial Intelligence

Moderator: Lt Gen James K. "Kevin" McLaughlin, USAF (Ret), President, McLaughlin Global Associates LLC

- Panelist: Walter O'Brien, Founder, Scorpion Computer Services
- Panelist: Dr. Edward M. Ochoa, Lt Col USAF (Ret), Senior Research Engineer, Machine Learning and Analytics, Georgia Tech Research Institute
- Panelist: Dr. Terry Wilson, Principal Electronics Engineer, Air Force Research Laboratory
- Panelist: Kevin Hall, Distinguished Engineer (DE) and Cognitive Solutions Expert, IBM Defense and Intelligence Services

Panel Session: Disruptive Technologies: Public/Private Partnerships

Moderator: Dr. Terry Pierce, Director, Center of Innovation, U.S. Air Force Academy, Special Advisor for DHS Science and Technology

- Panelist: James Cole, Senior Director, Security Architecture and Strategic Planning, Intel Corporation
- Panelist: Cherylene Caddy, Former White House Director for Cyber Policy Integration and Outreach

- Panelist: Lt Gen Bradford J. Shwedo, Chief, Information Dominance and Chief Information Officer, Office of the Secretary of the Air Force
- Panelist: Jason Upchurch, Computer Security Architect, Intel Corporation
- Panelist: C1C Dane Hankamer, U.S. Air Force Academy

Panel Session: Delivering Value as a Small Business

Moderator: Ken Loy, Chair, NDIA C4ISR Committee

- Panelist: ML Mackey, CEO, Beacon Interactive Systems
- Panelist: Tom Weithman, Managing Director and Vice President, Center for Innovative Technology
- Panelist: Dr. Ellen Ferraro, Director, Research and Technology, Integrated Defense Systems, Raytheon Company

Wednesday, March 7, 2018

Admin Remarks

- Lt Gen Robert Elder, USAF (Ret), Chair, NDIA Cyber and Emerging Technologies Division

Keynote Speaker

- Gen Stephen W. Wilson, USAF, Vice Chief of Staff, U.S. Air Force

Panel Session: Augmented Reality

Moderator: Lauren Hamburg, Augmented Reality Business Development Lead, Newport News Shipbuilding

- Panelist: Jason Ingalls, CEO, Ingalls Information Security
- Panelist: Paul Davies, Electrical Engineer, Project Manager, & Associate Technical Fellow, The Boeing Company
- Panelist: Frank Serna, Director, Draper Laboratories
- Panelist: Joshua Burns, Simulations Engineer and Augmented Reality Subject Matter Expert, Honeywell

Panel Session: Cyber-Human Systems

Moderator: Maj Gen Jim Keffer, USAF (Ret), Director Cyber, Lockheed Martin

- Panelist: Kevin Yin, CEO, SitScape, Inc.
- Panelist: Dr. James Kilbride, Director of Augmented Reality, General Dynamics Mission Systems
- Panelist: Dr. Robert Hoffman, Senior Research Scientist, Institute for Human & Machine Cognition
- Panelist: Dr. William Casebeer, USAF (Ret), Senior Manager, Human Systems and Autonomy, Lockheed Martin

- Panelist: Col William D. Bryant, USAF, Deputy Chief Information Security Officer for Mission Assurance, Office of Information Dominance and Chief Information Officer, Secretary of the Air Force

Lunch & Interactive Speaker - "Ask Scorpion"

- Walter O'Brien, Founder, Scorpion Computer Services

Panel Session: Virtual Training Systems

Moderator: RADM James A. Robb, USN (Ret), President, National Training and Simulation Association

- Panelist: Walter O'Brien, Founder, Scorpion Computer Services
- Panelist: Paul Biegel, Program Manager, Interactive Simulations, The Johns Hopkins University Applied Physics Laboratory
- Panelist: Jeff Fisher, Virtual Reality Lab Manager, National Institute for Aviation Research, Wichita State University
- Panelist: Eric Spalding, Advanced Technology Lead, The Boeing Company

Panel Session: Physical System Replication

Moderator: Lt Gen Robert Elder, USAF (Ret), Chair, NDIA Cyber and Emerging Technologies Division

- Panelist: William Cave, CEO, Prediction Systems Inc.
- Panelist: Dr. John J. Kelly III, President, Model Software Corporation
- Panelist: Philomena Zimmerman, Deputy Director for Engineering Tools and Environments, ODASD(SE)
- Panelist: Dr. Sridhar Lakshmanan, Associate Professor, Electrical and Computer Engineering, University of Michigan-Dearborn

Keynote Speaker

- Chris Inglis, Managing Director, Paladin Capital Group

Closing Remarks

- Lt Gen Robert Elder, USAF (Ret), Chair, NDIA Cyber and Emerging Technologies Division

GAP CIE Brief to the NDIA Capabilities for Senior Decision Makers Panel

Bryan Bartels

6 Mar 2018

What is GAP CIE?

- **A web based application using common enterprise services and joint planning processes to provide a joint planning and situation awareness application with shareable information for simultaneous use by multiple Services, Commands, Agencies, Allies and Organizations**

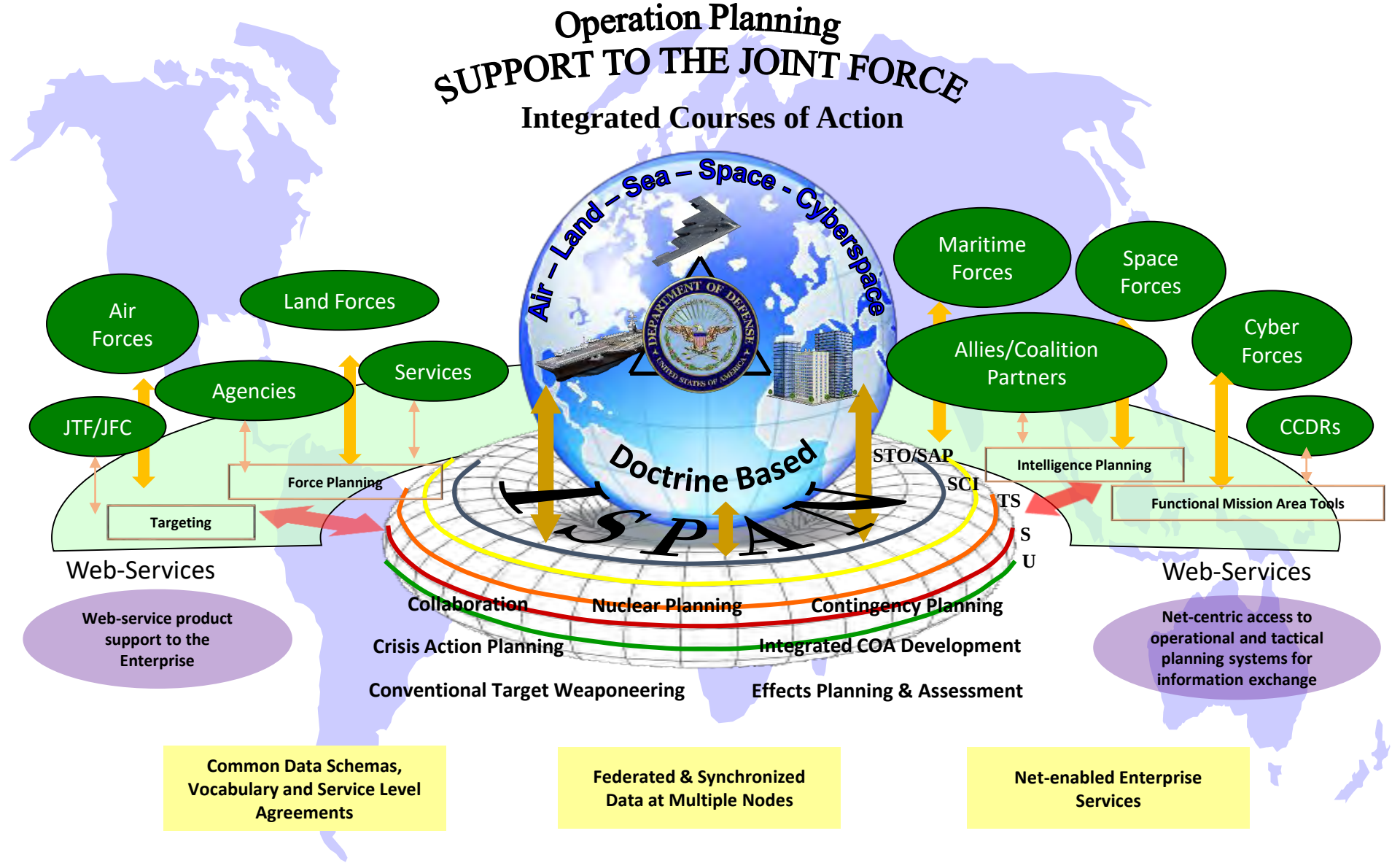
- **GAP CIE is an operational application that was developed to orchestrate the Joint Planning Process (JPP) and is the Department of Defense (DoD) Program of Record for Joint Strategic Course of Action (COA) Development**

- **Resides on JWICS, SIPRNet, and SIPR-Rel (USA, AUS, CAN, GBR, and NZL) enclaves, allowing staffs to include Allied partners in planning and sharing of situational awareness**

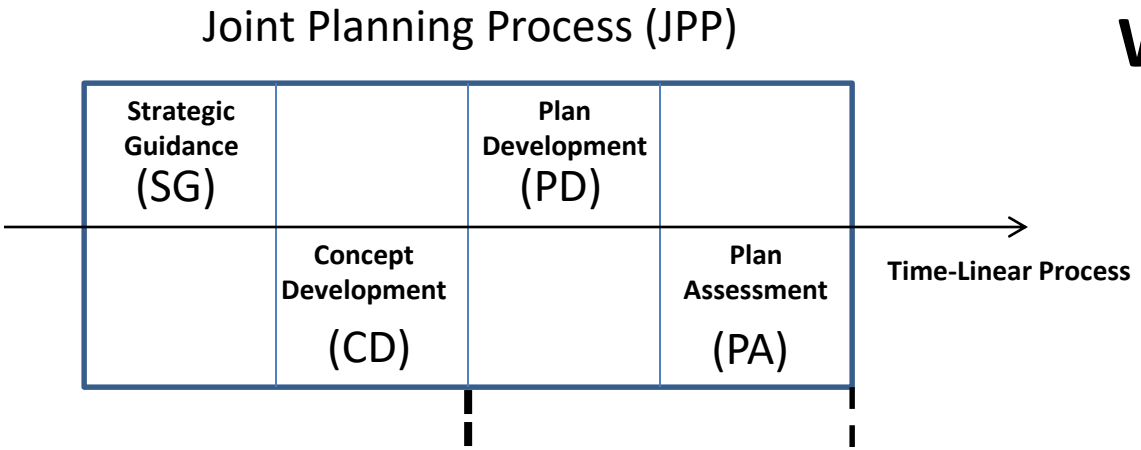
Importance to Senior Leaders

- **GAP CIE provides the visualization of data via three main outputs; briefings, documents and dashboards**
- **Dashboards provide the user the capability to simply and effectively display data**
- **Dashboard content is completely user configurable and displays specific data and data types required to provide Senior Leaders with near real-time Situational Awareness**
- **Data sources include information from various Portlet records within the GAP CIE workspaces and authoritative external sources and websites via the Global Situational Awareness Tool (GSAT)**
- **Distributed, collaborative planning enabling time sensitive vs. time consuming serial planning**

Global Adaptive Planning Collaborative Information Environment (GAP CIE)

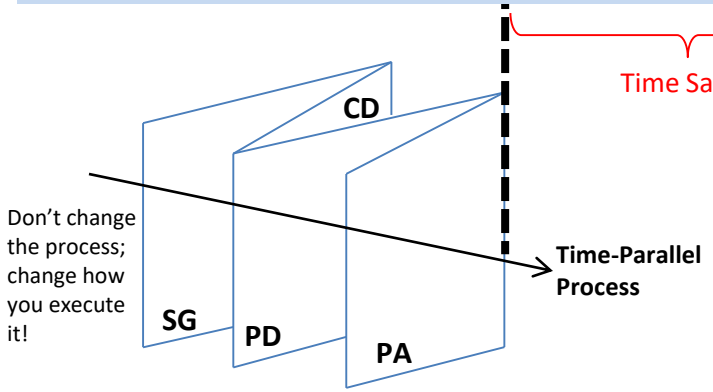


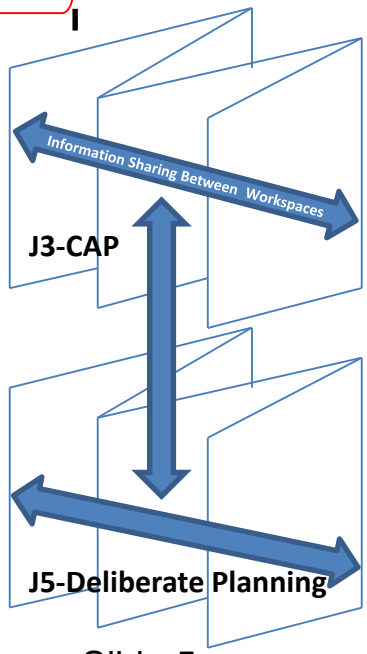
What does GAP CIE DO?



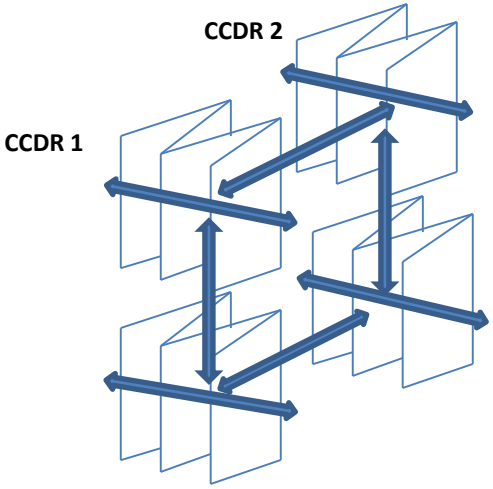
Problem: No Machine-to-Machine or application-enhanced collaboration; just white boards and PowerPoint. Bottom Line: It takes too long to develop complex, integrated, and resource-constrained plans.

GAP CIE Solution: Machine-to-Machine collaboration via a common C2 application with access to and orchestration of authoritative data to deliver a process structured-CDR centric-User driven planning capability. Conceptually, the application **"Folds"** the JPP through parallel, integrated planning workspaces to couple the work of the J3 and J5 (plus J2 Intel & support staff) within an organization and also among different organizations.





Plus SA, Orders, JIPOE (J2 Intel) & Authoritative Data Enablers



Integrated Planning among multiple CCDRs, JTFs, Allies and Coalition partners with User defined Access Controls

GAP CIE enables Planners of all experience levels to create more options of better quality; faster

Modernizing the Legacy Application

- GAP CIE 2.0 (GC2) is a wholesale transformation vs legacy GAP CIE
  - Improved user interface
  - Easier to use and train
  - User defined planning provides flexibility and much greater capability
  - Reduced software modification costs
  - Deployments of new code require mere minutes vs hours
  - 60% more cost efficient to sustain
- System automatically gives your data structure and semantic meaning
- Output types include: Briefings, Documents and Dashboards
- Briefings and Documents can be exported to MS Office equivalents or as an XML file for consumption by other programs

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Decision Support Moving to the Mobile Edge*

March 2018

Dr. Jim Gump
Jim.gump@jhuapl.edu

*Additional details available in the full journal article


Research Paper

An Architecture for Agile Systems Engineering of Secure Commercial Off-the-Shelf Mobile Communications

Introduction:
Government Developed vs COTS

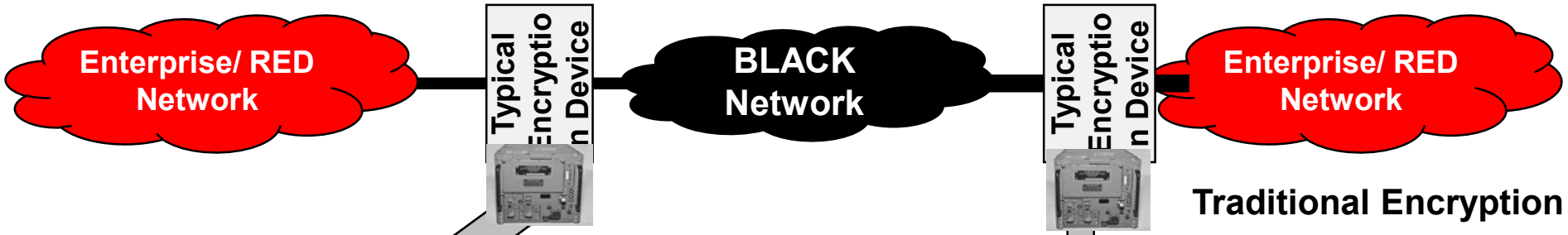
Secure Mobile Environment Portable Electronic Device (SME PED)

Latest Commercial Tech (Secured with Commercial Encryption)

Years to Develop, Obsolete when fielded …

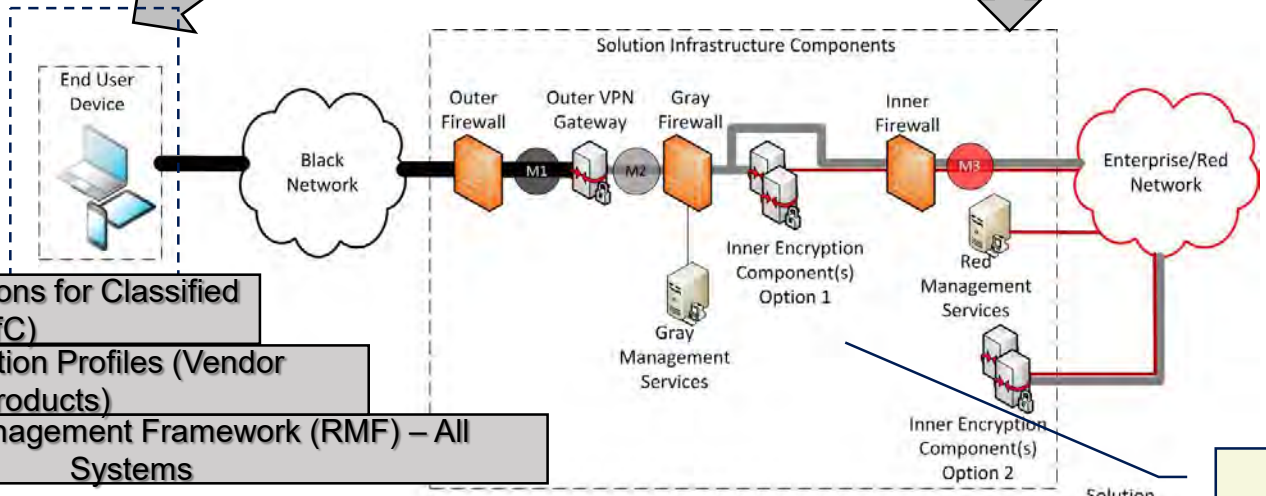
Introduction

New Paradigm for Encryption "Devices" (derived from NSA MACP)



Traditional Encryption

CSfC Approach



Standards Hierarchy

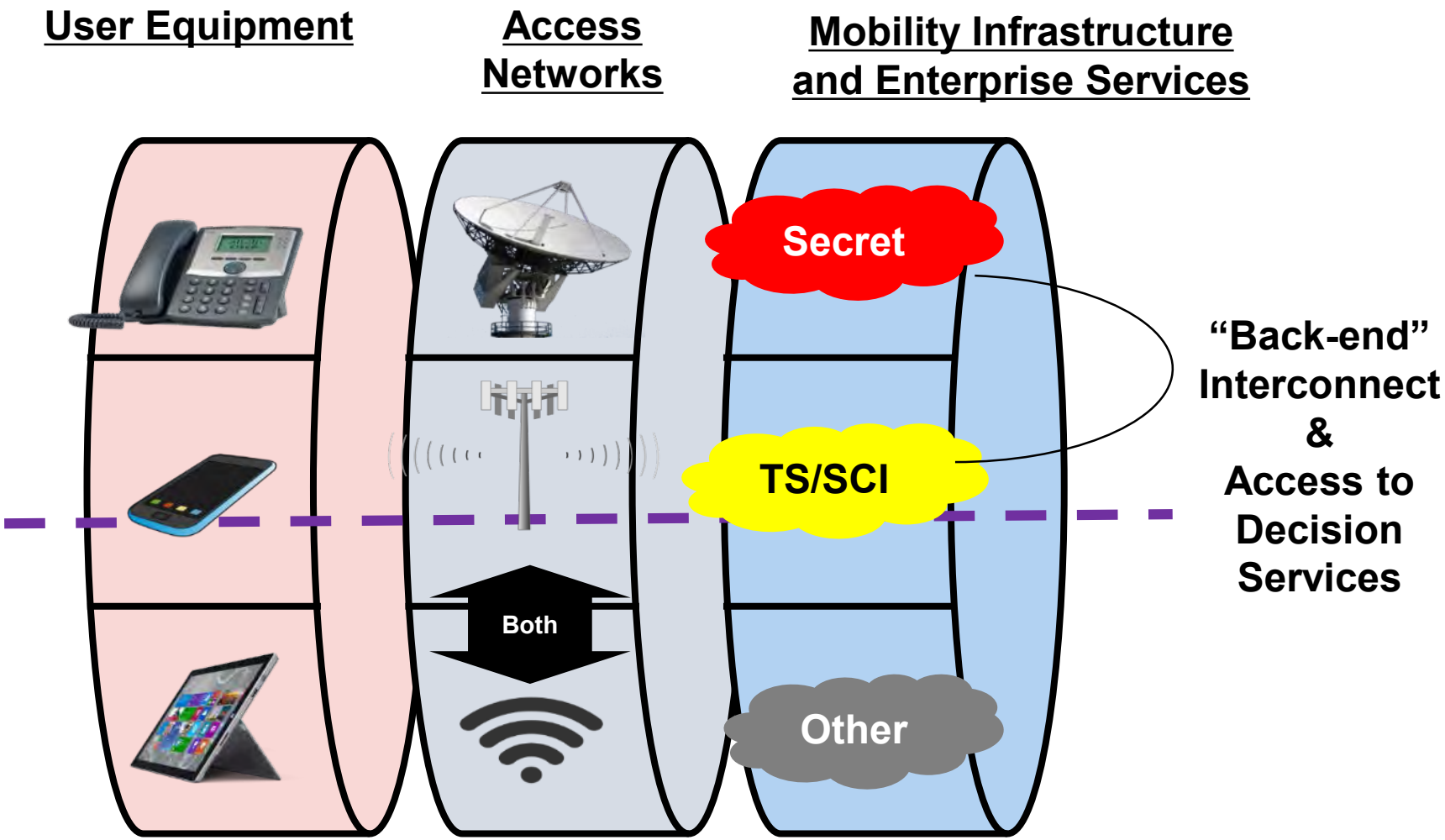
- Commercial Solutions for Classified (CSfC)
- NIAPP Protection Profiles (Vendor Products)
- NIST Risk Management Framework (RMF) – All Systems

Mobile Access Capability Package Ver .8, National Security Agency (NSA)

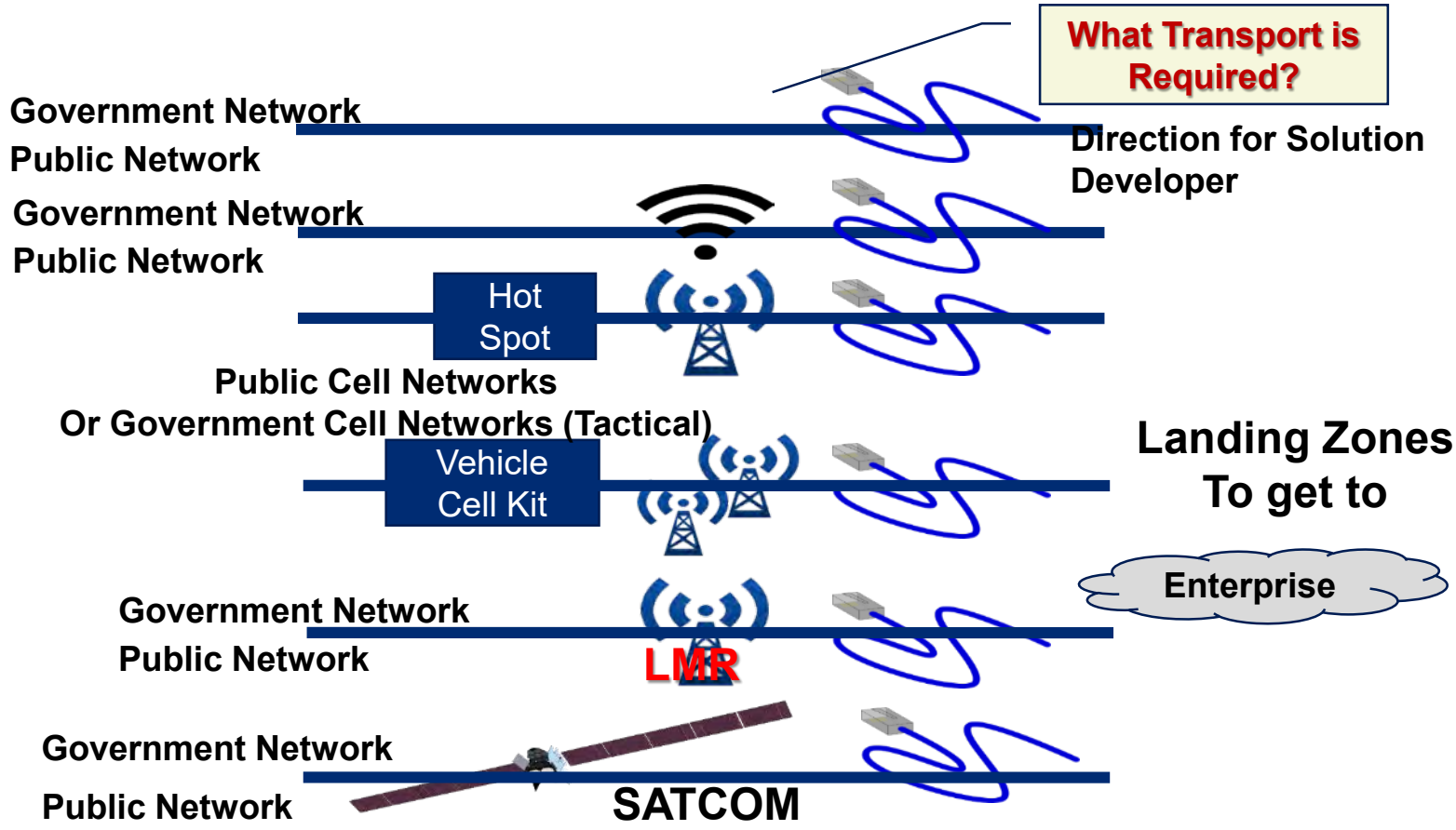
COTS Monitoring (Cyber tools)

Typical Government (NSA) Developed Encryption (mil spec. box) Replaced by Commercial IT – VPN Tunnel inside another Tunnel

Combination Lock Analogy ("Dial" a Configuration)



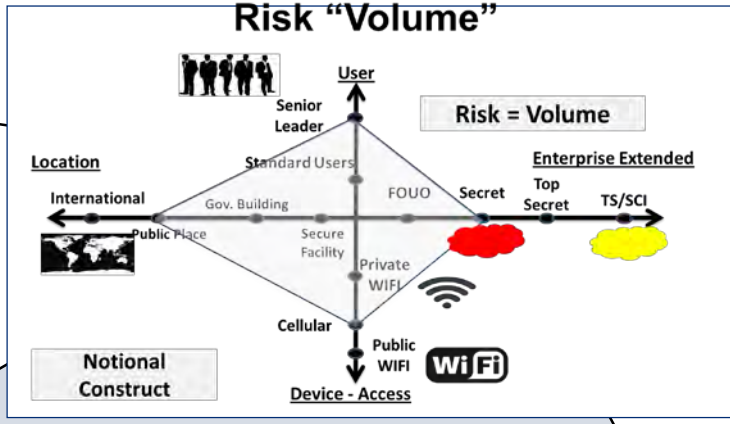
Operational Viewpoint
A Sampling of Transport Alternatives



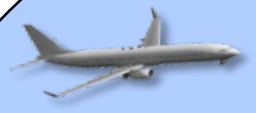
Don't forget the Threat – Signal Intercept, Cyber, etc (Risk)

Explore all the Alternatives and Consider Risk to Each and Locations Required will Drive the Transport Options

Architecture Foundation
High Level Requirements & Associated Risk



1. User(s) & Required Applications
- Senior Leader, Comms Officers, etc
- Voice, Video, Email, C2, BA, etc



4. Location(s)
- Aircraft, Vehicle, on foot, etc
- Government and/or Commercial
- US and/or OCONUS

Composed Solutions

2. Enterprise Extended
- Enterprise unclass, Secret, TS/SCI, etc
- Services available

3. Device(s) & Transport
- Phone, Tablets, Laptops, etc
- w/ WIFI, Cellular, etc

Using the High Level Requirements the Risk can be Illustrated as "Volume"

Operational Viewpoint - End User Capabilities

Required EUDs?

Direction for Solution Developer

- and/or -

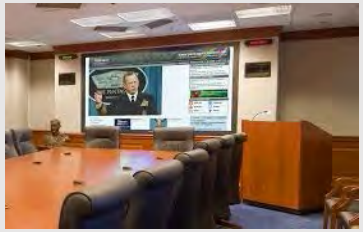
Required Aps?

@ Classification Level?

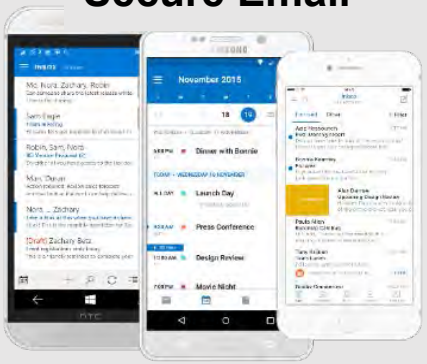
Enterprise Services

Secure Phone

Secure VTC



Secure Email



Classified is “Secure”

Command and Control Applications

Streaming Video

C2 Applications available in fixed Locations

Other C2 Aps – Tracking Phones etc

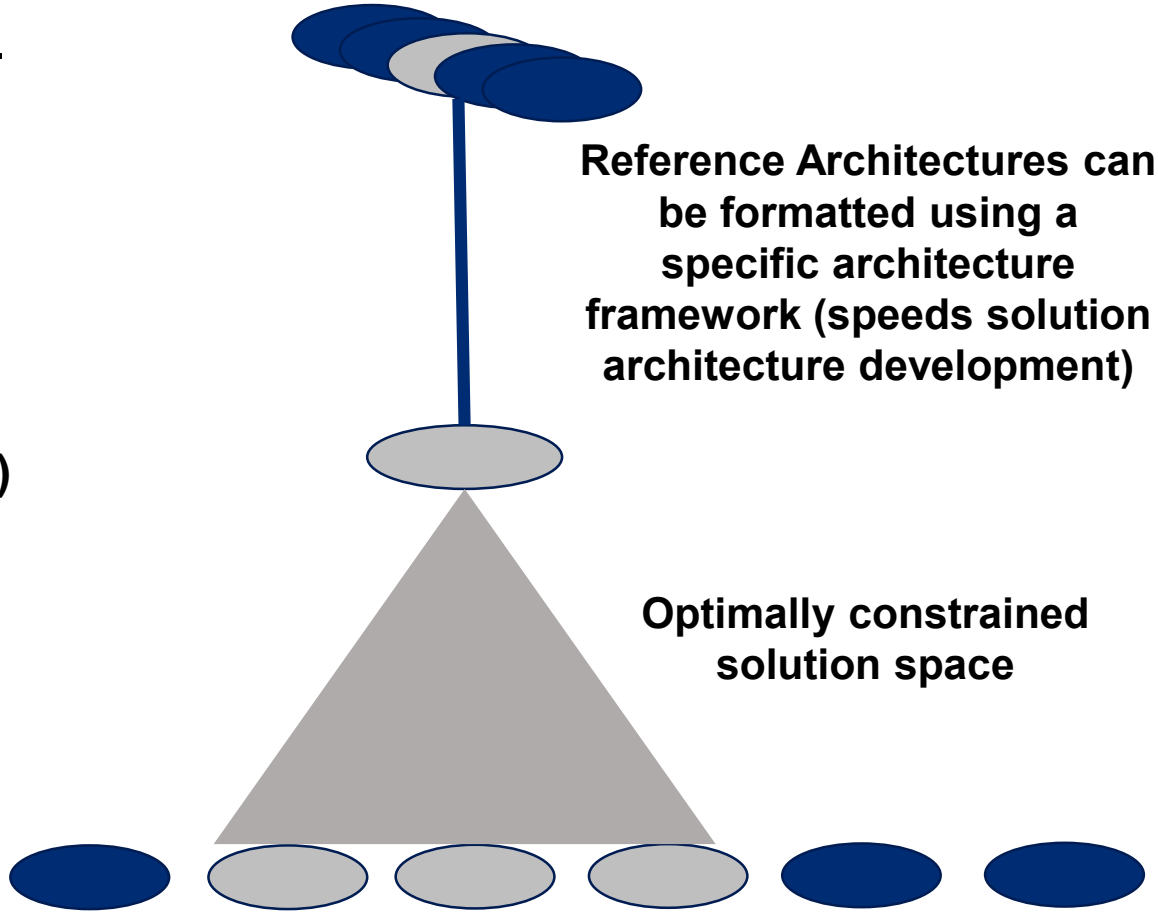
Bringing Secure/Classified Communications to the end user on-the-move (all locations) using all commercial Technology

Reference Architecture or Technical Patterns (for family of solutions)

Architecture Frameworks
(DODAF, etc)

Reference Architecture Or Technical Pattern
(for a specific application)

Solution Architecture/ Solution Space
(for specific application)



Reference Architectures can be formatted using a specific architecture framework (speeds solution architecture development)

Optimally constrained solution space

All Architectures are not the same – Use Framework, Solution, Reference, Enterprise Arch. with Caution – Each are Defined and Use will Vary

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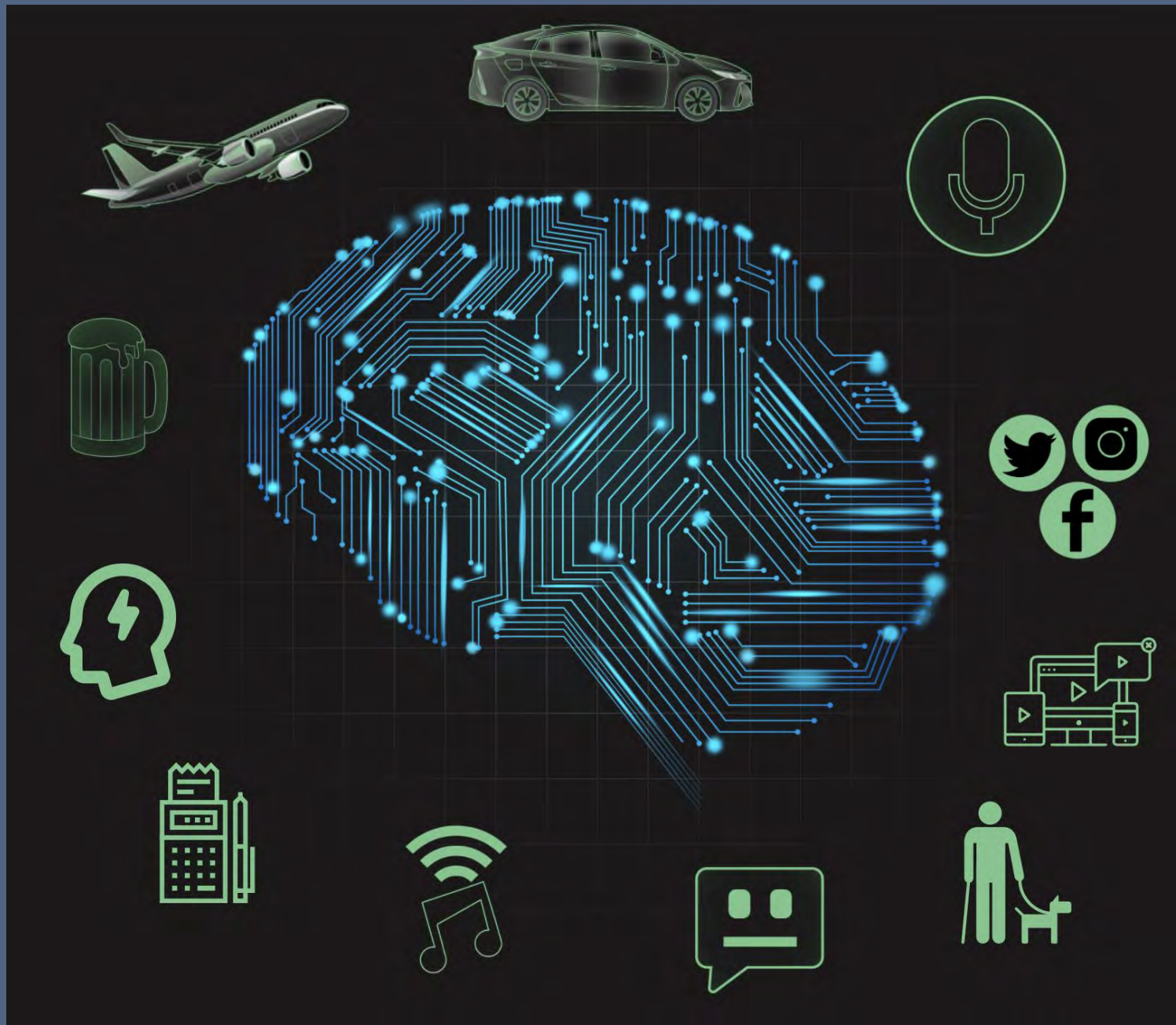
Artificial Intelligence
and Cognitive Computing



Kevin Hall

IBM Distinguished Engineer

US Defense and Intelligence Services

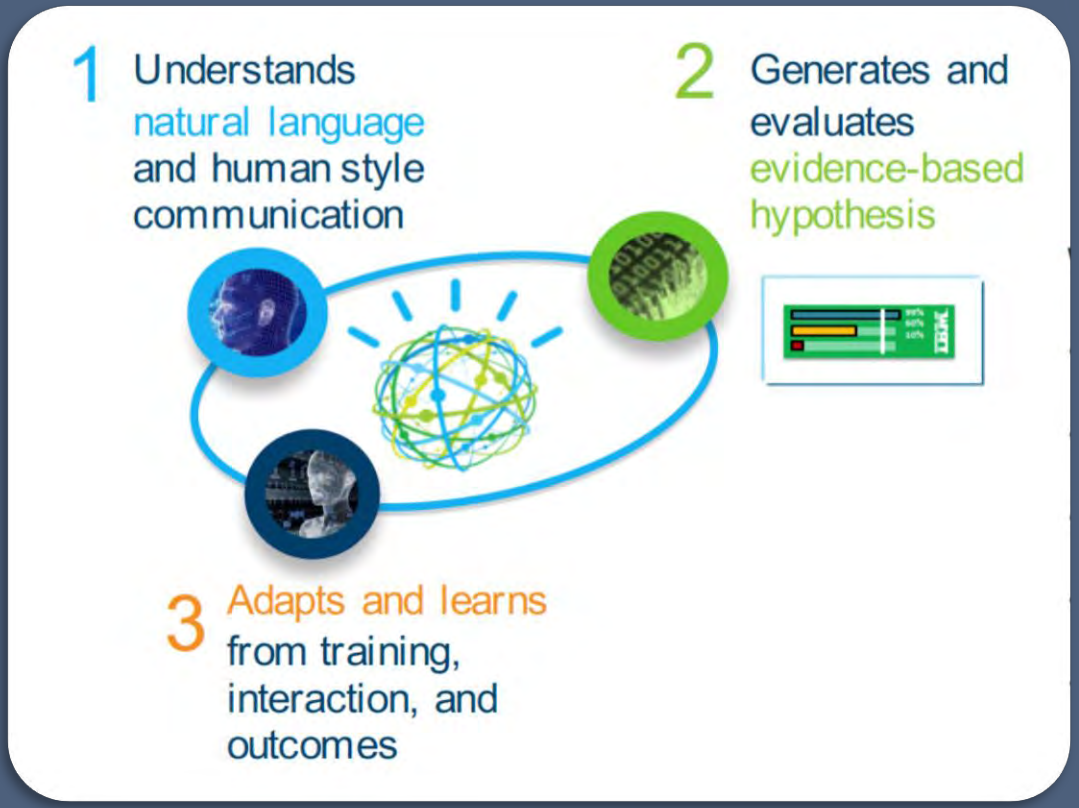
03/06/2018

Outline

- **AI and "Cognitive Computing"**
- **Status and Usage**
- **Applicability for DoD of On-Premise Cognitive/AI**
  - Critical Criteria for Selecting AI/Cognitive for DoD
- ***Adoption* and *Ethical* Aspects of AI / Cognitive**

IBM View of AI and "Cognitive Computing"

1. Understands



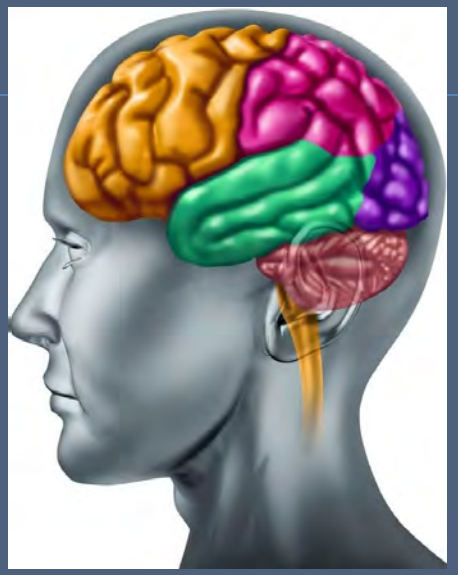
2. Reasons

3. Learns

The AI…
- Understands me
- Engages me
- Learns & improves over time
- Helps me discover
- Establishes trust
- Has endless capacity for insight
- Operates in a timely fashion

What makes AI offerings *different*?
- Understanding: Speech, text, data, images
- Reasoning: Patterns, Neural, Deep
- Learning: Trained, Supervised, Unsupervised, Challenge-driven
- Outputs: On-screen, voice, actions
- Deployment: Embedded, augmented, stand-alone

Cognitive Principles

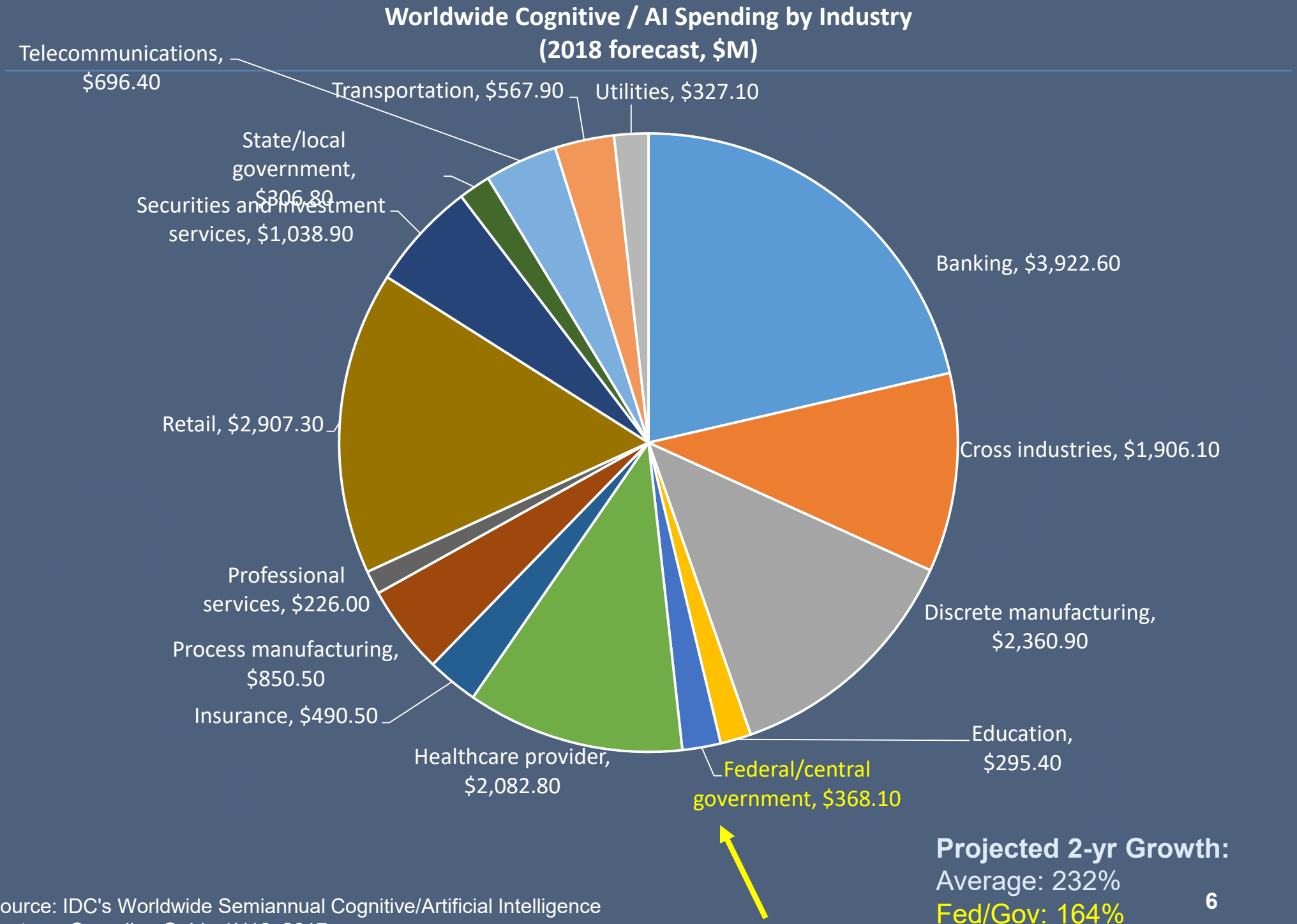


- **Better data = better outcomes**
- **Training > Programming**
- **AI anxiety?... Think IA (Intelligent Assistant)**
  - Ingest much more information
  - Make additional observations
  - See non-obvious relationships; removal of bias
  - Perform repetitive and boring tasks

Status: How did we get here?

- **IT Technology Evolution:**
  - Data growing faster than processing, disk I/O, networking
  - So, more data ***exists*** than can be ***used*** … *in time*.
  - Result: Data-centric systems that minimize data movement
- **Overall Technology Evolution:**
  - Exponentially growing tech *converges*, disrupting industries
  - Computing, Robotics, Sensors, AI, Communications, Mobile
- **Systems Evolution:**

Usage: Where is the Spending on AI?



Source: IDC's Worldwide Semiannual Cognitive/Artificial Intelligence Systems Spending Guide 1H16, 2017

Usage: Where is AI being used Every Day?

Very Common

- Voice Assistants
- Chatbots
- Social Media
- GPS
- Commercial air travel
- Music Streaming
- Drones
- Taxes
- Order fulfillment
- Advertising / shopping
- Customer Advisors

Specialties

- Medical diagnosis (oncology)
- Alcohol production
- Farming
- Energy optimization
- Logistics
- Image processing
- Business Analytics
- Art (movie trailers, books)
- People matching
- Weather forecasting
- Hyper-Local Marketing

Usage: “Local” / Specific AI

- Healthcare (oncology)
- Data Mining/Discovery
- Chat bots
- Personnel
- Finance
- Sourcing
- “Automation”
- Geospatial
- Social Media Extraction
- Plant Advisor
- Business Foresight
- Process Automation
- Customer Care
- Video Processing
- Audio Processing
- Causation Models
- Tutors
- Cyber Security

Applicability for DoD of On-Premise Cognitive/AI

- Fleet / Forces Readiness and Maintenance
- Imagery/Video Exploration, Recognition, Extraction
- Cognitive Situational Understanding
- Cybersecurity
- Social Media Data Mining
- Virtual Advisor / Conversation Services (Chatbots)
- Data Mining/Exploration (search & content analytics)
- Business Decision Support (*various*)

Critical Criteria for Selecting AI/Cognitive for DoD

- **Functional**
  - Cognitive and Processing Dimensions
    - Understand, Reason, Learn
    - NLP, Analytics, Geospatial, Data Management, Predictive/COAs
  - Inputs
    - Text, Data, Multimedia, Social, Cyber, Sensors, Events, Legacy
  - Outputs
    - Screen, Audio, Robotics, IT Action, Event Transmission, Geospatial,…
- **Co-Existence**
  - Integration (in/out)
  - Migration Potential (in/out)
  - Pre-Requisites (software, licensing, data, rights)
- **Deployment**
  - Hosting Needs: Local/DIL vs. On-Premise vs. Cloud
  - NFRs: Security/RMF, Scalability, Admin Needs, Extensibility
  - Costs: Skills, Services, Software, Training, etc.

Top *Adoption* and *Ethical* Aspects of AI / Cognitive

- **Purpose**
  - *Question*: Should AI obtain consciousness or independence?
  - Ethical AI: Augment human capability. Do this:
    - Extend human capability, expertise and potential
    - Embed in human-controlled processes, systems, products, services
- **Transparency**
  - *Question*: Should we have confidence in AI's recommendations, judgments and uses?
  - Ethical AI: Make AI reasoning and training transparent. Make clear:
    - Usage: When and why AI is being applied
    - Training: What data, expertise, and methods trained the AI
    - Rights: Our clients own their own models, IP, and data
- **Skills**
  - *Question*: How do we factor the human's skills affected by AI?
  - Ethical AI: Help people acquire new skills and knowledge to engage with AI systems, and perform new kinds of work that emerge.

https://www.ibm.com/blogs/think/2017/01/ibm-cognitive-principles/

So, Our Priorities for AI Adoption and Ethics

- **Purpose: human augmentation versus replacement**
  - Human decision-making
  - Human judgement, morals and intuition
- **Transparency in training, data, reasoning, & sources**
  - Clear inferences
  - Sources and reasoning
  - Protection of data and rights
- **Skills training and education**
  - There is a shortage of workers with the skills needed to work in partnership with AI systems
  - Emphasize skills rather than degrees

https://www.ibm.com/blogs/policy/kenny-artificial-intelligence-letter/

Backups

AI Glossary

Artificial Intelligence – Any technique that enables computers to mimic human intelligence (warfighter intelligence), using logic, if-then rules, decision trees and machine learning to support the warfighter**.**

Machine Learning (ML) – The subset of AI that includes statistical techniques that enable machines to improve at tasks with experience. Machine Adaptation to the Army warfighter.

Deep Learning (DL) – The subset of ML composed of algorithms that permit software to train itself to perform tasks in support of the warfighter functions. Like speech (language detection, language translation, voice to text, text to voice AI services), image & visual recognition (digital imagery, digital video), by exposing multi layered neural networks to vast amounts of big data on the asymmetric battlefields of the future.

Neural Networks / Neural Nets (NNs) – Virtual software constructions modeled after the way adaptable networks of neurons in the brain are understood to work, rather than through rigid instructions predetermined by humans.

Natural Language Processing (NLP) – The computer processing that takes place in speech-recognition technology, in which software is able to recognize spoken sentences and is able to re-create spoken language into text.

Cognitive systems rely on collections of data and information…

Data, information, and expertise create the foundation.

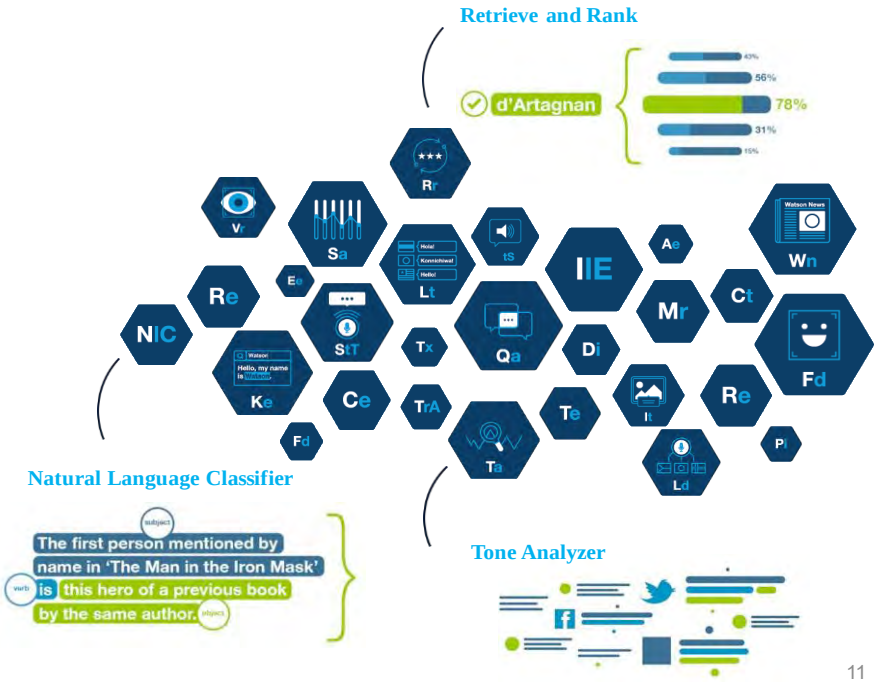
Examples include:

- Analyst reports
- tweets
- Wire tap transcripts
- Battlefield docs
- E-mails
- Texts
- Forensic reports
- Newspapers
- Blogs
- Wiki
- Court rulings
- International crime database
- Stolen vehicle data
- Missing persons data

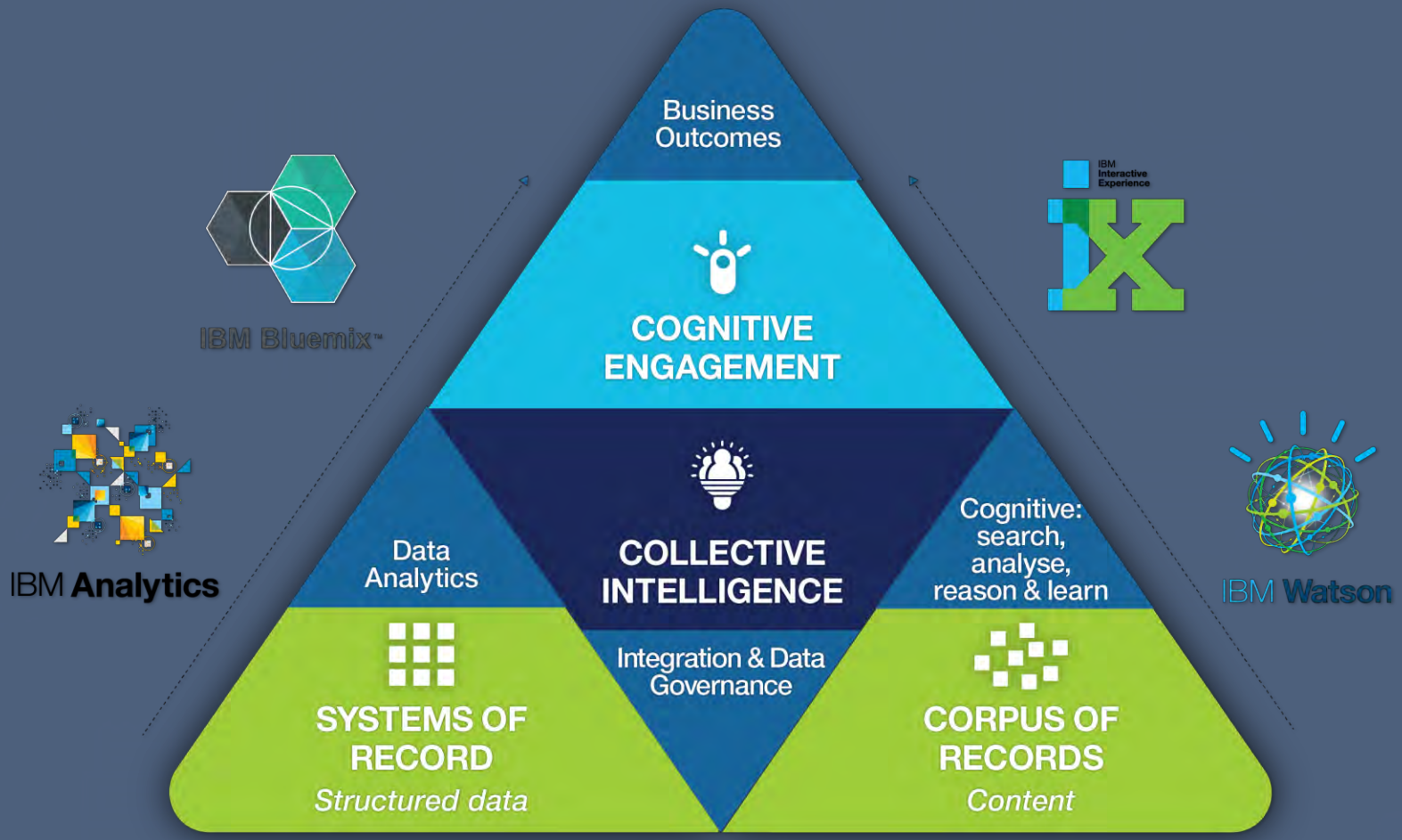
…and then leverage IBM Watson APIs to apply cognitive capabilities.

50 underlying technologies

- Entity Extraction
- Sentiment Analysis
- Emotion Analysis (Beta)
- Keyword Extraction
- Concept Tagging
- Taxonomy Classification
- Author Extraction
- Language Detection
- Text Extraction
- Microformats Parsing
- Feed Detection
- Linked Data Support
- Concept Expansion
- Concept Insights
- Dialog
- Document Conversion
- Language Translation
- Natural Language Classifier
- Personality insights
- Relationship Extraction
- Retrieve and Rank
- Tone Analyzer
- Emotive Speech to Text
- Text to Speech
- Face Detection
- Image Link Extraction
- Image Tagging
- Text Detection
- Visual Insights
- Visual Recognition
- AlchemyData News
- Tradeoff Analytics



Cognitive Systems: IBM brings the power a holistic cognitive analytics ecosystem to address these specific needs



AI in Popular US/English Movies

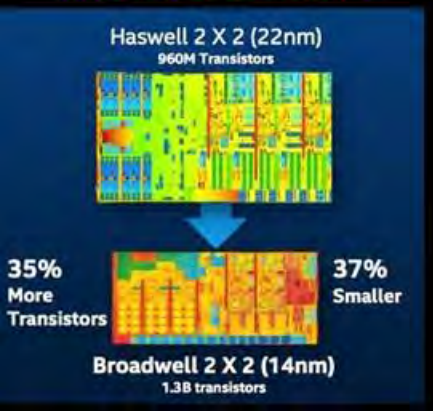
Creation Date	Movie title	The Artificial Intelligence...	Country
1921	Mechanical Man	... commits crime acts, following human directions	Italy
1927	Metropolis	... obeys her/its creator's command to cause chaos	Germany
1936	Undersea Kingdom	... kills enemies as remote controlled fighting robots	US
1939	The Phantom Creeps	... intends to destroy the human race	US
1941	The Mechanical Monsters	... commits crimes and destroys	US
1954	Gog	... destroys and kills people	US
1957	Kronos	... fights to harvest all forms of energy for an alien race	US
1961	Invasion of The Neptune Men	... intends to obsess the Earth to destroy the human race	Japan
1968	A Space Odyssey	... due to a malfunction kills the spaceship crew to defend itself	US
1977	Star Wars	... helps people in general (C3PO and R2D2)	US
1980	D.A.R.Y.L.	... looks as a 10-year-old boy, a supercomputer with human feelings	US
1982	Blade Runner	... serves mankind as short-life "replicants" but seeks for freedom	US - Austral
1984	Terminator	... comes back from the future to change history by killing a human	US-UK
1986	Short Circuit	... is a military robot with a sense of free will	US
1987	RoboCop.	... servs and protects humanity, fights crime	US
1991	Terminator 2 - Judgement Day	... comes back from the future to change history by killing a human	US-France
1999	The Matrix	... keeps mankind in slavery, locking them in a simulated reality world	US - Austral
2001	A.I. Artificial Intelligence"	... intends to get back to its human "mother"	US
2003	Terminator 3 - The Rise of the Machines	... comes back from the future to change history by killing a human	US-German
2004	I, Robot	... intends to free-up robotic race from human oppression	US
2005	The Hitchhiker's Guide to the Galaxy	... is paranoid and depressed that they cannot use their planet-size brain :)	UK-US
2008	Wall-E	... falls in love while cleaning up the post-apocaliptic planet Earth	US
2009	Terminator - Salvation	... thinks, feels, acts like a human - and sacrifices himself for humans	US-German-Italian
2013	The Machine	... created as super-soldier but becomes more human than its creators	UK
2014	Autómata	... intends to ensure the robotic race evolution	Spain-Bulgaria
2015	Ex Machina	... succeeds a Turing-test, falls in love with a human and escapes	UK

The Overall Global IT Outlook is toward *Understanding*

Automating the World

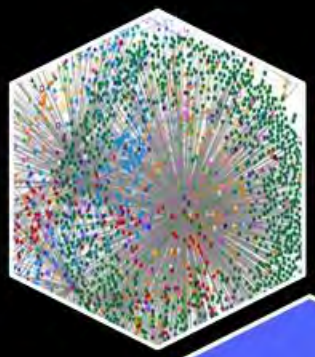
Understanding the World

Moore's Law



Broadwell delivers:

- 2.2x increase in transistor density
- Up to 40% better 3D graphics perf[1]
- Enables <9mm fanless designs

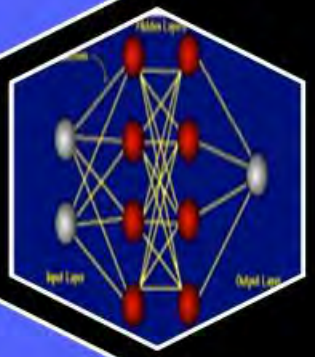


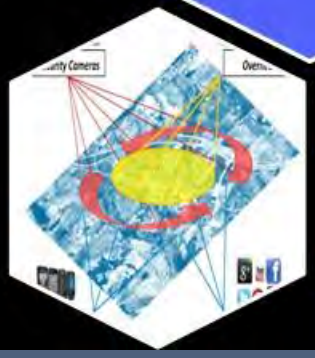
Graph Analytics

Genomics
Social Networks
Security

Healthcare
Education
Internet of Things

Machine Learning





Video, Speech Analytics

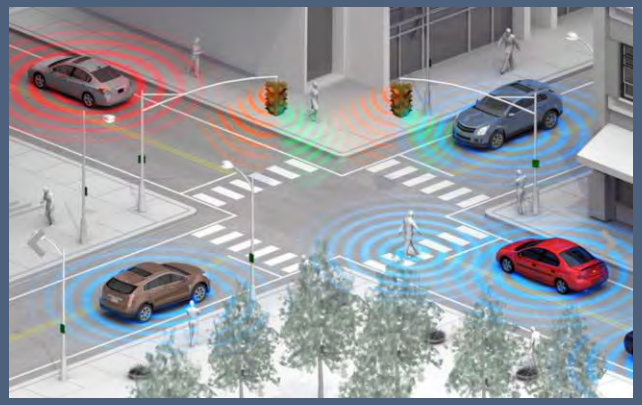
Object recognition
Complex video analytics
Multi-model analytics

IBM Watson

Source: IBM Global Technology Outlook, Jan 2016
"IBM Research: Foundations for Cognitive Business"

Cognitive Computing

- **A cognitive system is not programmed. It gathers data, makes observations, and learns through experience.**
- **Pragmatic Artificial Intelligence (Cognitive Computing) enhances our ability**
  - Specific task
  - Stated and measurable goal / success criteria
  - A smart agent that helps you achieve that success
- **Example: Advanced Automotive Technology.**
- **You have 2 eyes; your car may have ~100**



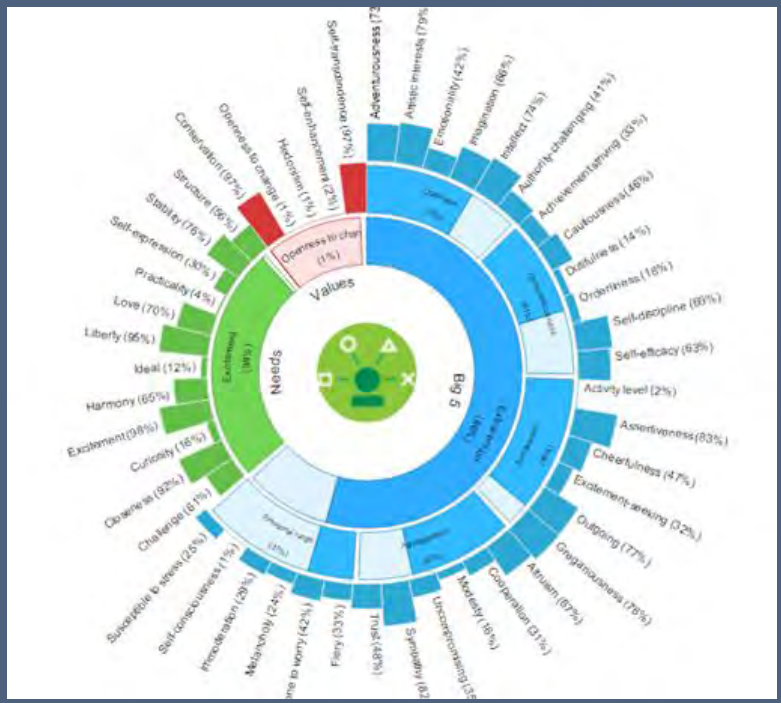
Source: Motortrend

Source: JDPowers

AI from the Cloud – 1 of 3

Personality Insights API

The Personality Insights service derives insights about personality characteristics from social media, enterprise data, or other digital communications.



- https://console.bluemix.net/catalog/services/personality-insights
- https://console.bluemix.net/docs/services/personality-insights/getting-started.html#getting-started-tutorial

AI from the Cloud – 2 of 3

Visual Recognition API (Object Classifier)

The Visual Recognition Service finds meaning in visual content! Analyze images for scenes, objects, faces, and other content.

- https://visual-recognition-demo.ng.bluemix.net/
- https://console.bluemix.net/docs/services/visual-recognition/getting-started.html#getting-started-tutorial

Visual Recognition API (Facial Recognition)

The Visual Recognition Service finds meaning in visual content! Analyze large volumes of unstructured data to conduct facial recognition through machine learning.

- https://visual-recognition-demo.ng.bluemix.net/
- https://console.bluemix.net/docs/services/visual-recognition/getting-started.html#getting-started-tutorial

AI from the Cloud – 3 of 3

Language Translator API

The Language Translator Service dynamically translate news, patents, or conversational documents? Instantly publish content in multiple languages? Supported languages include:

Afrikaans, Albanian, Arabic, Azerbaijani, Bashkir, Belarusian, Bulgarian, Bengali, Bosnian, Chinese, Traditional Chinese, Czech, Chuvash, Danish, Dutch, German, Greek, English, Esperanto, Spanish, Estonian, Basque, Farsi/Persian, Finnish, French, Gujarati, Hebrew, Hindi, Haitian, Hungarian, Armenian, Indonesian, Icelandic, Italian, Japanese, Georgian, Kazakh, Central Khmer, Korean, Kurdish, Kirghiz, Lithuanian, Latvian, Malayalam, Mongolian.

https://console.bluemix.net/docs/services/language-translator/getting-started.html#gettingstarted

https://language-translator-demo.ng.bluemix.net/

Text to Voice API
Voice to Text API

The Text to Voice API processes text and natural language to generate synthesized audio output complete with appropriate cadence and intonation. It is available in several voices.

https://console.bluemix.net/catalog/services/text-to-speech

https://text-to-speech-demo.ng.bluemix.net/

Top Ethical Issues with AI / Cognitive

1. **Should AI obtain consciousness or independence?**
   - At issue: Autonomous systems (e.g. self-driving cars)

2. **Should we have confidence in AI's recommendations, judgments and uses?**
   - At issue: Trusted systems (e.g. medical diagnosis).

3. **How do we factor the human's skills affected by AI?**
   - At issue: Human-system relationship (e.g. robotics)

4. **Should we allow any use of the results?**
   - At issue: Usage rights (e.g. genomics data used for discrimination)

HQ U.S. Air Force Academy

Integrity - Service - Excellence

UNITED STATES AIR FORCE ACADEMY

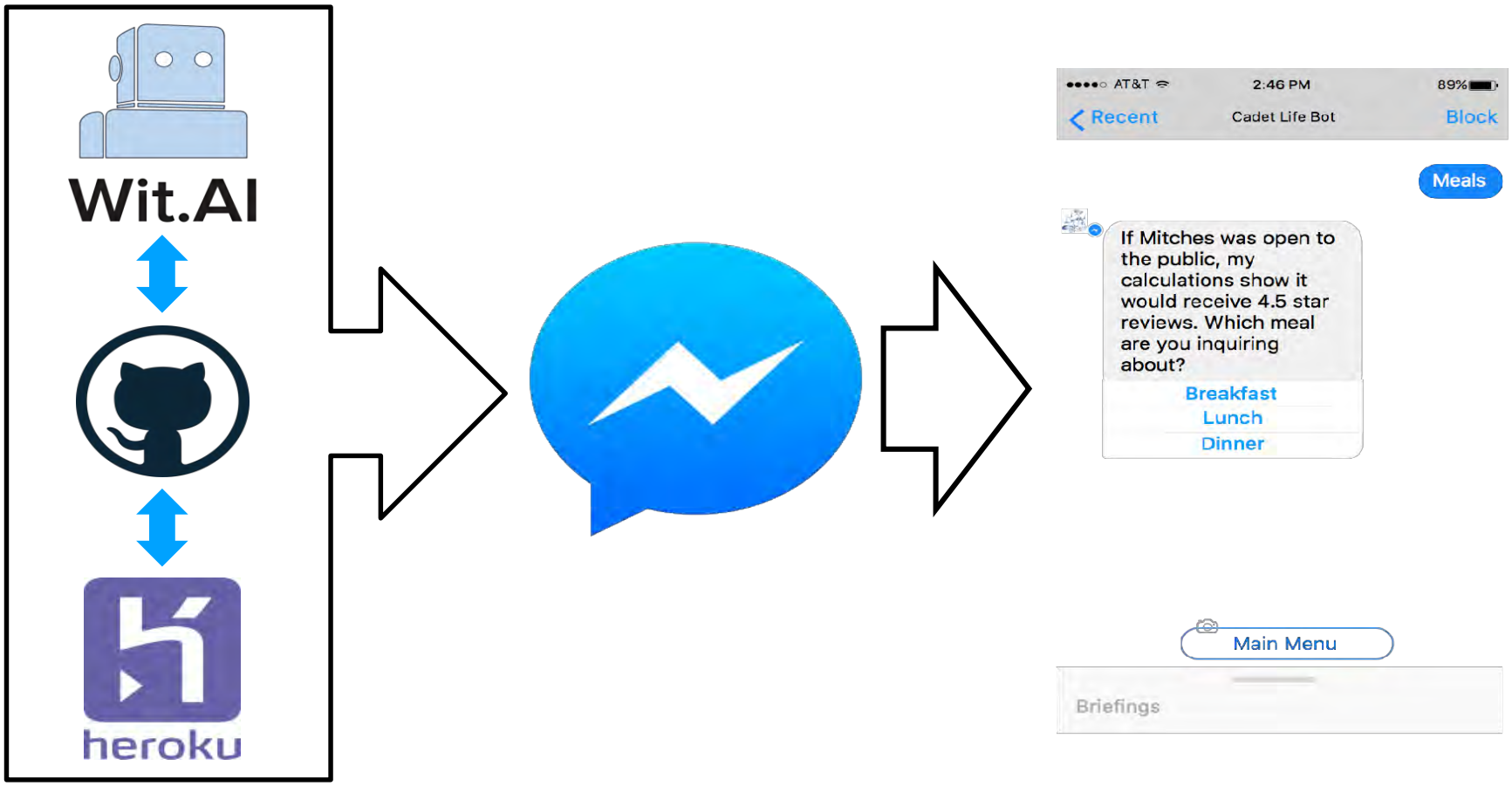
Facebook Summer Research: AI Chatbot Technology

DHS Center of Innovation

C1C Dane Hankamer

UNITED STATES AIR FORCE ACADEMY

What is an AI chatbot?

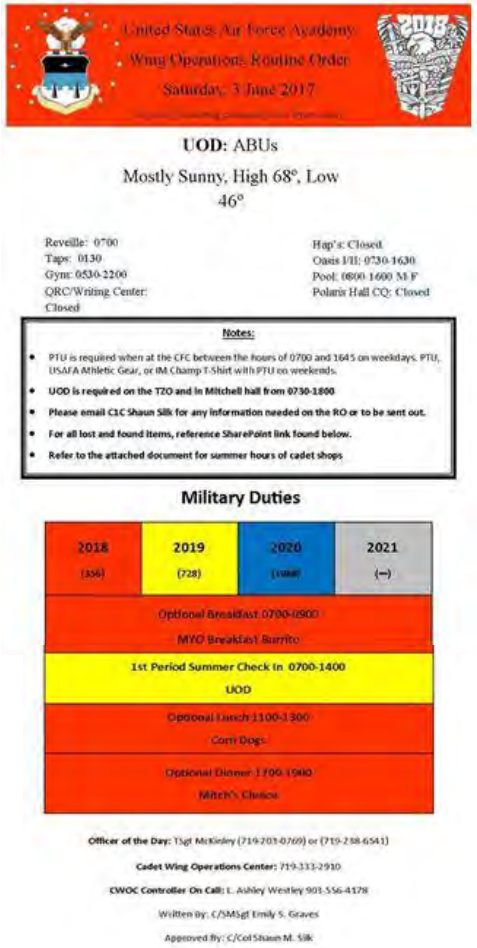


Think 'App', except you are texting a robot that performs tasks

UNITED STATES AIR FORCE ACADEMY

Cadet Life Bot

- Problem Solved for Cadets!
- Timely process to open OPORD
- Bot stores daily meal, briefing and uniform information



United States Air Force Academy
Wing Operations Routine Order
Saturday, 3 June 2017

UOD: ABUs

Mostly Sunny, High 68°, Low 46°

Reveille: 0700
Taps: 0130
Gym: 0530-2200
QRC/Writing Center: Closed

Hap's: Closed
Oasis I/II: 0730-1630
Pool: 0800-1600 M-F
Polaris Hall CQ: Closed

Notes:

- PTU is required when at the CFC between the hours of 0700 and 1645 on weekdays. PTU, USAFA Athletic Gear, or IM Champ T-Shirt with PTU on weekends.
- **UOD is required on the TZO and in Mitchell hall from 0730-1800**
- **Please email C1C Shaun Silk for any information needed on the RO or to be sent out.**
- **For all lost and found items, reference SharePoint link found below.**
- **Refer to the attached document for summer hours of cadet shops**

Military Duties

2018 (356)	2019 (728)	2020 (1068)	2021 (—)

Optional Breakfast 0700-0900
MYO Breakfast Burrito

1st Period Summer Check In 0700-1400
UOD

Optional Lunch 1100-1300
Corn Dogs

Optional Dinner 1700-1900
Mitch's Choice

Officer of the Day: TSgt McKinley (719-203-0769) or (719-238-6541)
Cadet Wing Operations Center: 719-333-2910
CWOC Controller On Call: C. Ashley Westley 903.556.4178
Written By: C/SMSgt Emily S. Graves
Approved By: C/Col Shaun M. Silk

Information is now at cadets' fingertips in Facebook Messenger

UNITED STATES AIR FORCE ACADEMY

Innovative Counterintelligence

- Flag and report terror-related posts
  - Retrieve user_post, user_location and name of user
- Potentially stop terrorist attacks before they occur, thereby *preserving property* and *saving lives*

Today I will blow up the Air Force Academy.

Entity: Time — Intent — Entity: Location

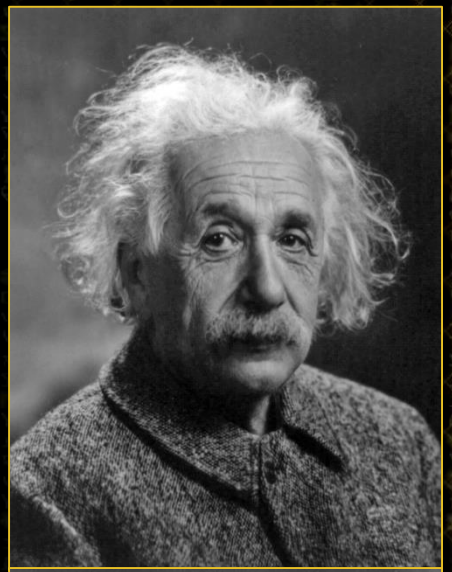
THREAT!

SCORPION

When Failure is Not an Option

Intelligence & Education

- Scorpion started company at 13 after hacking incident
- Hired other prodigies with Hi-IQ
- Hired super nannies with Hi-EQ to re-engineer ourselves
- Formed a think tank as a home for the mentally enabled
- Innovated 150+ products and processes



IQ Vs EQ

Worked With

US Army Joint Systems Integration Lab

US Navy Command & Control System

Largest Mutual Fund $1.9 Trillion

Largest Electrical Utility Provider

Largest Insurance Company

Largest CC Company

Largest Casino Group

Largest Healthcare

Large Government Systems

Scorpion: The Real Company Behind the TV Drama

1. There's a place for everyone who never fit in
2. Every problem has a solution
3. Celebrate intelligence before sports

Community Impact: HP Code Wars California Science Center State Science Fair

ScenGen Summary

RAF automates the running of tests.

ScenGen automates the “thinking” of tests. ScenGen is an AI engine that generates all possible scenario combinations for a given App Model

Windows, Linux, Unix & VMs supported

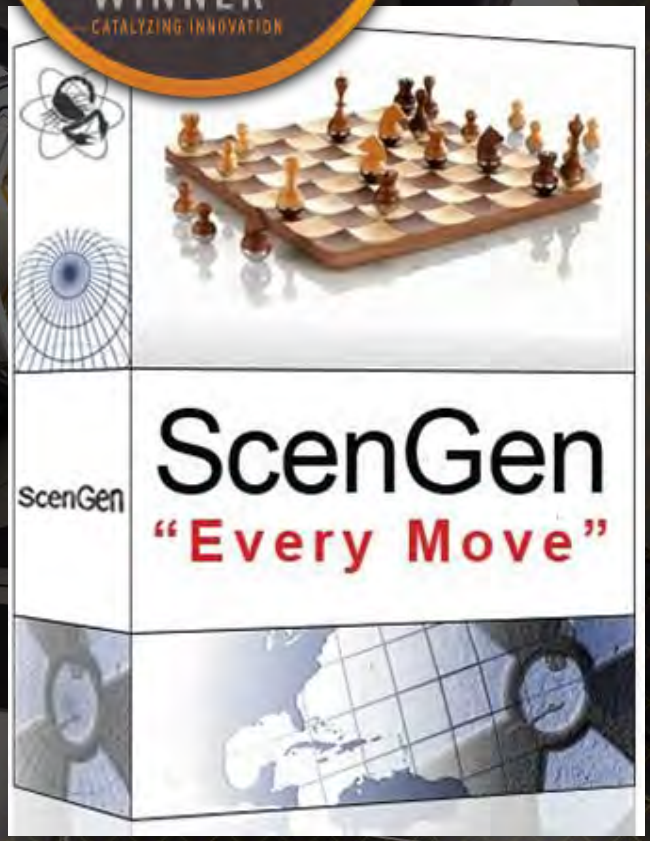
Legacy Systems support

System of Systems support (switching)

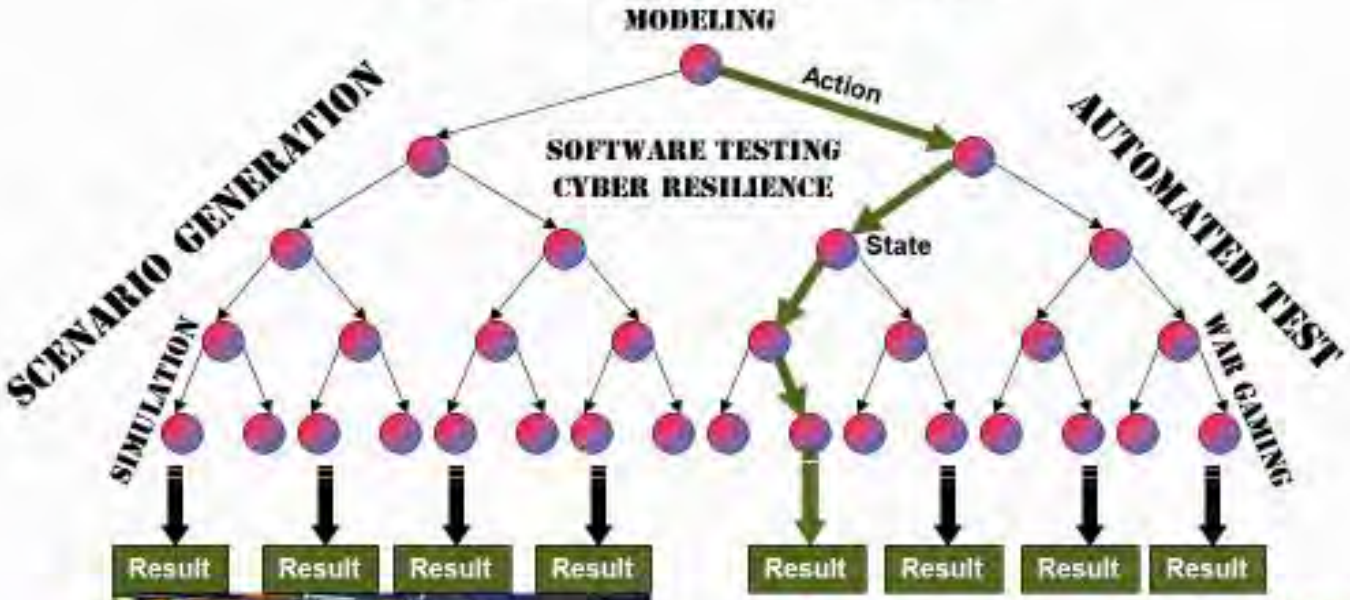
Remote access support

100% environment integrity

No local network access, No source code access, No target install, Language agnostic



Scientific Approach



Unlimited Applications

- Scorpion Cyber Vault
- National Background Investigation Bureau
- CYBER Testing
- UAS Swarm Warfare

ScenGen combines the following techniques:

- Forward Tracking general problem search (GPS)
- Back Tracking general problem search (BGPS)
- Finite State automaton
- Deterministic and Nondeterministic
- In a single recursive algorithm
- In raw ANSI C (No MS Libraries)
- With a scalable virtual pointer tree structure

Push Button Rapid Automation

ScenGen Mission Planning

- ScenGen Model of Afghan network
- Replacing the “Chess” pieces with all known variables

Separating a cats whiskers from it's hairs

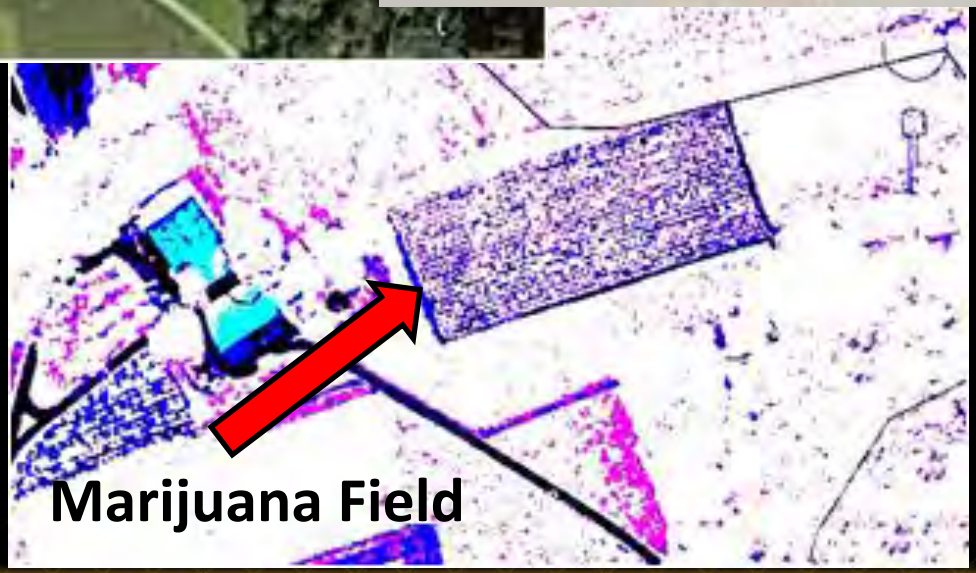
1. Motion = 8.73463 pixels/frame.
2. Motion = 20.5689 pixels/frame.
3. Motion = 14.0997 pixels/frame.
4. Motion = 13.2854 pixels/frame.
5. Motion = 18.4901 pixels/frame.

Tracking low resolution camouflaged objects

Intelligent Surveillance from 30,000 ft.

THIRD ARM

Intelligent Surveillance



siliconrepublic BUSINESS DISCOVERY CAREERS LIFE VIDEO MORE

Irish computer genius 'Scorpion' lands AI drone deal with US Army

by John Kennedy

18 JAN 2018 117 SHARES

The US Army's MQ-1C Warrior UAV. Image: US Army

Irishman with hit US TV show based on his life to bring AI to cutting edge of tomorrow's battlefield.

ScenGen Unmanned the Unmanned Aerial Vehicle (UUAV)

Weekend takeaway: Living to learn

1 DAY AGO

New stunning image of the cosmos reveals 'eggcellent' bird-like galaxy

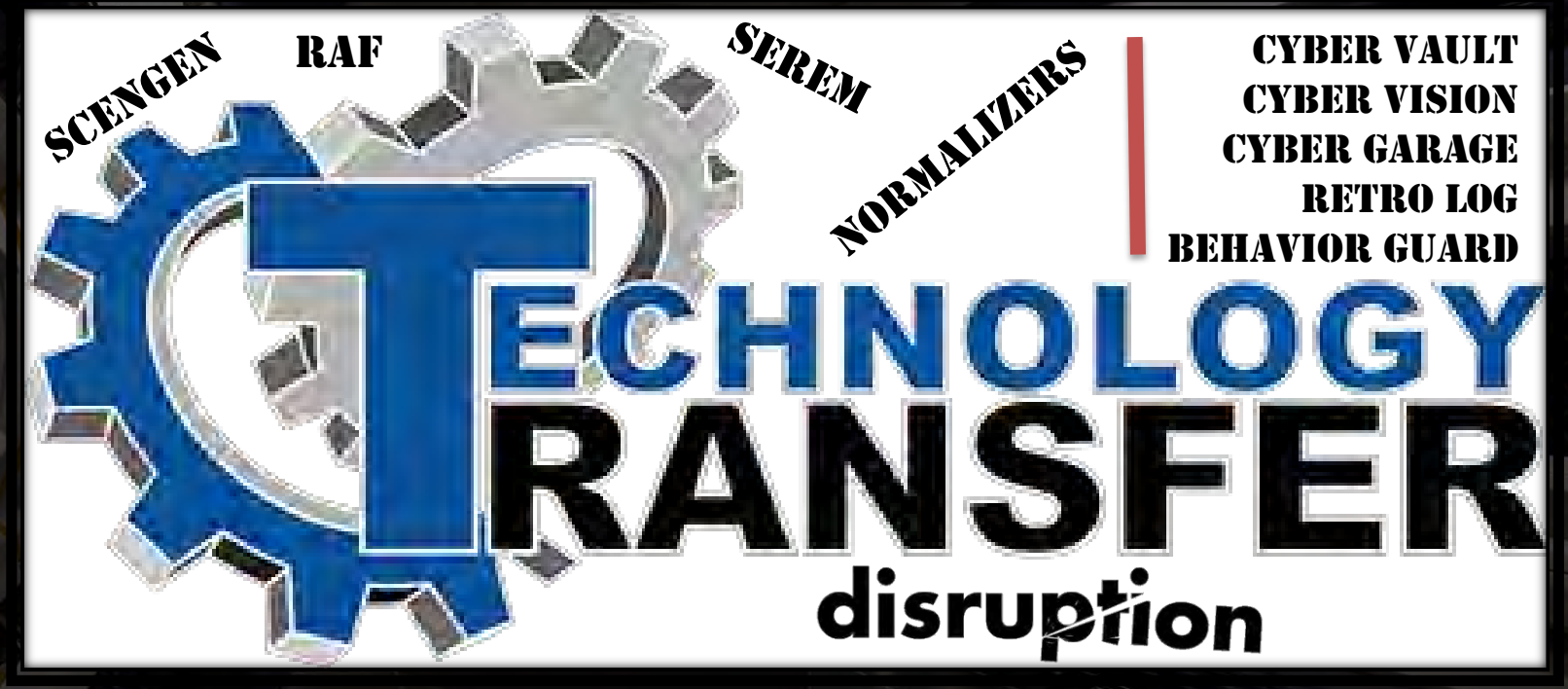
1 DAY AGO

HSE interim CIO Jane Carolan: 'Data is untapped wealth for health'

1 DAY AGO

Vodafone IoT Barometer 2017/18 is available now

Scorpion Commercial to Government Tech Transfer

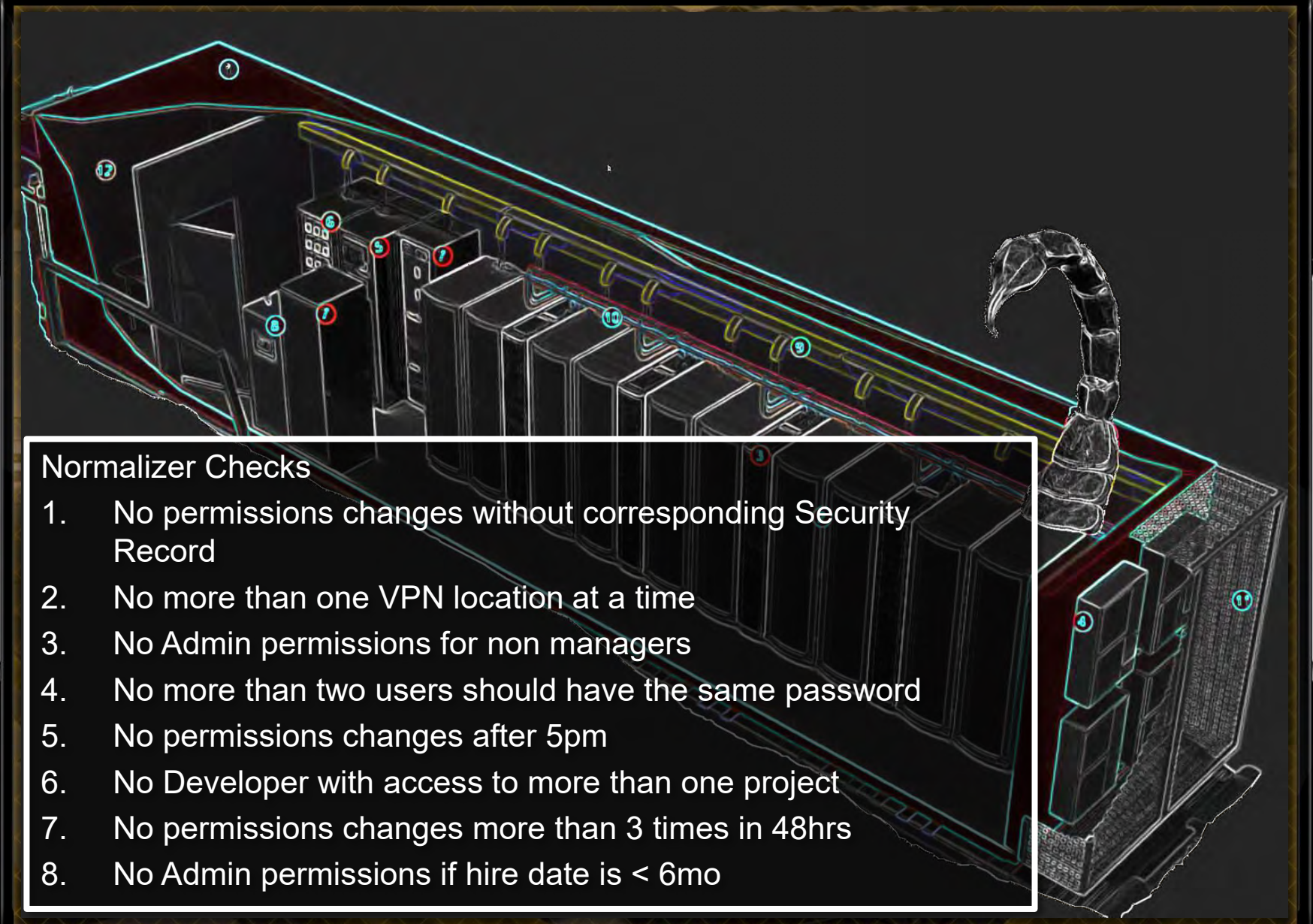


SCORPION COMPUTER SERVICES

Scorpion Cyber Vault (SCV)

Securing the System, its Configuration and the Data

Author: Walter O'Brien, Revision 1.0



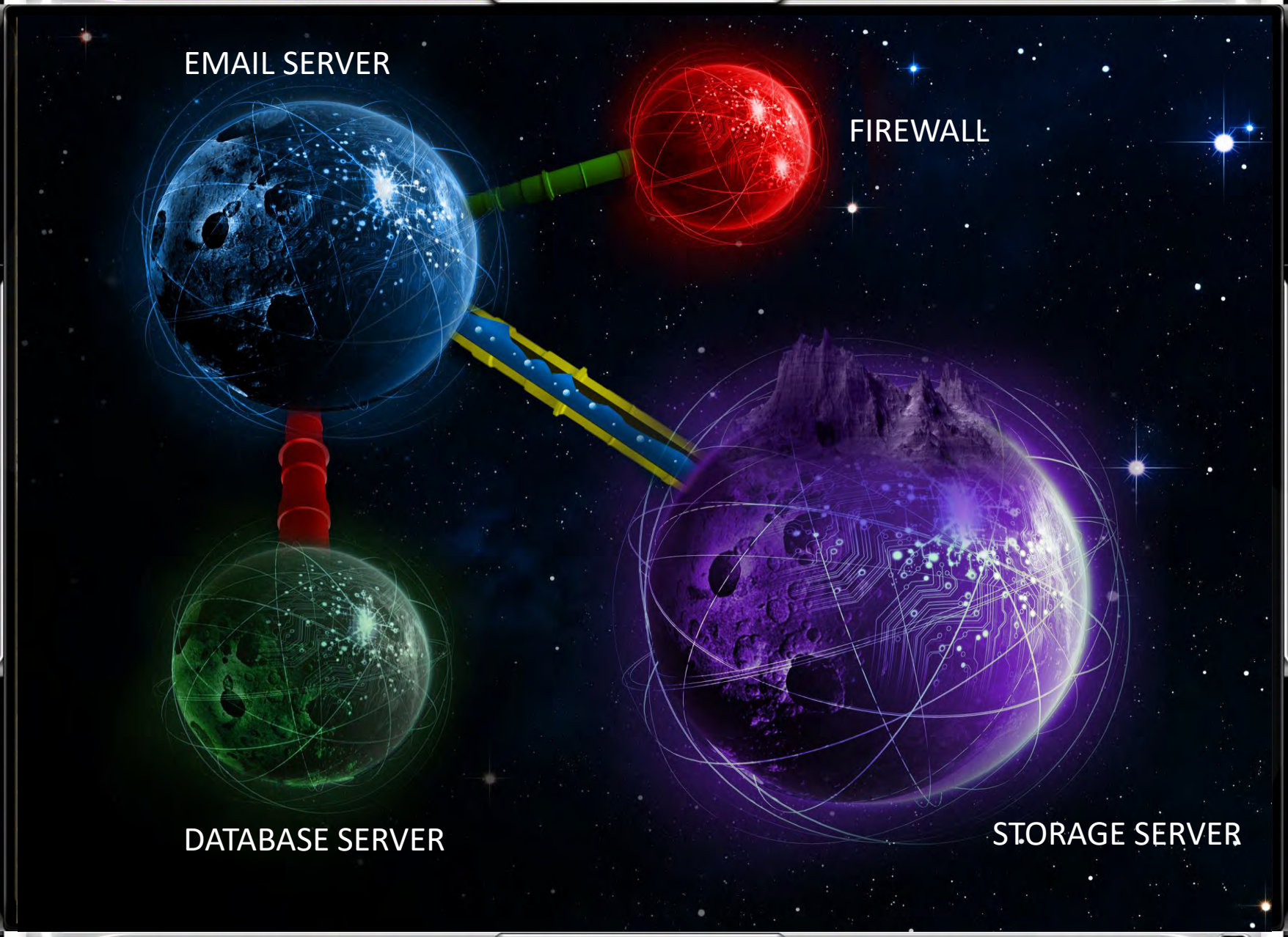
Normalizer Checks

1. No permissions changes without corresponding Security Record
2. No more than one VPN location at a time
3. No Admin permissions for non managers
4. No more than two users should have the same password
5. No permissions changes after 5pm
6. No Developer with access to more than one project
7. No permissions changes more than 3 times in 48hrs
8. No Admin permissions if hire date is < 6mo

CYBER Vault

Cyber Vision

- We process visuals 60,000x faster than text.
- Visual analogies:
  - Systems = Planets
  - Security Vuls = Craters
  - Bandwidth Usage = Size
  - Communication = Gravity
  - Network = Pipelines
  - Data Flow = Water streams
  - Abnormalities = Acne
- All in Oculus Rift!

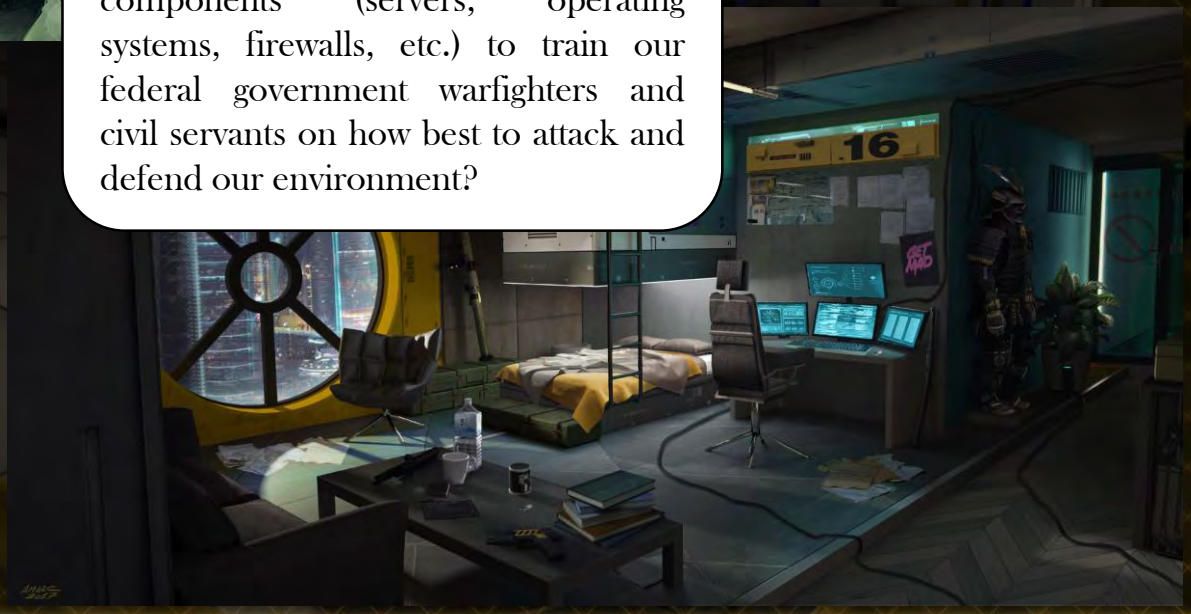

EMAIL SERVER
FIREWALL
DATABASE SERVER
STORAGE SERVER

CYBER Garage

Configure and deploy entire CYBERtropolis ranges “on demand” based on the user needs

Imagine if a CYBER garage was set up with all the latest cyber technology components (servers, operating systems, firewalls, etc.) to train our federal government warfighters and civil servants on how best to attack and defend our environment?

Think of it as highly adaptable motion picture set but in the CYBER virtual environment.



RETRO LOG

Modern systems exist that can analyze detailed system logs and determine if the behavior of the application is appropriate

- The majority of government systems are legacy and don't have detailed logging
  - Limiting their ability to take advantage of this modern day cyber security technology.
- Re-writing these systems would be cost prohibitive

- Imagine if a system was smart enough to automatically know where to retro-fit modern logging code into legacy systems bridging this technology gap

Scorpion Retro-log is a system that addresses this challenge.

Behavior Guard

The data gap:

"our ability to gather data had exceeded our ability to make use of it"

The Behavior Guard consolidates disparate, non-standard, non-active directory, non-integrated admin and security systems across platforms. Write access is optional.

If you can see it, we can automate it

1 The accelerating pace of change...

Agricultural Revolution ← 8,000 years → Industrial Revolution ← 120 years → Light-bulb ← 90 years → Moon landing ← 22 years → World Wide Web ← 9 years → Human genome sequenced

2 ... and exponential growth in computing power...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS
By calculations per second per $1,000

Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems

Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II

UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

Apple II
At a price of $1,298, the compact machine was one of the first massively popular personal computers

Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
SINAC
IBM SSEC
EDVAC
Whirlwind
Datamatic 1000
IBM 1620
DEC PDP-10
DEC PDP-8
IBM 1130
Data General Nova
Intellec-8
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC

ELECTROMECHANICAL — RELAYS — VACUUM TUBES — TRANSISTORS — INTEGRATED CIRCUITS

1900 1920 1940 1960 1980 2000 2011 2020 2045

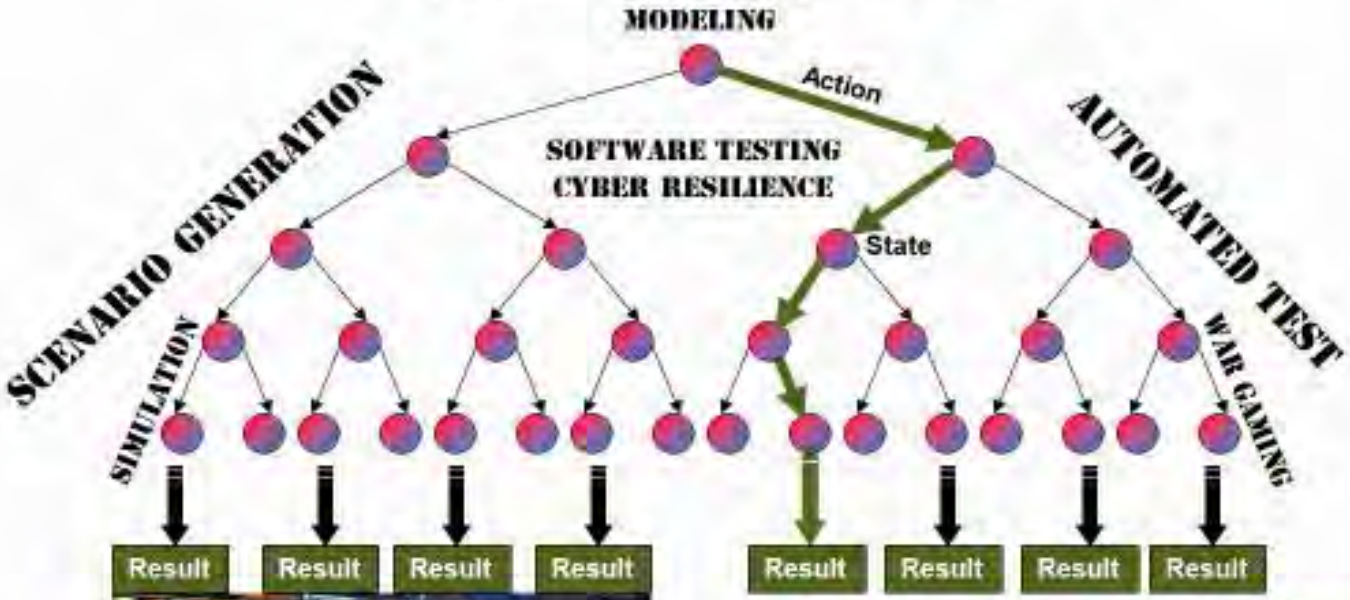
10^{16} — **2045** Surpasses brainpower equivalent to that of all human brains combined
10^{12} — Surpasses brainpower of human in 2023
10^{15}
10,000,000,000 — Surpasses brainpower of mouse in 2015
100,000
1
0.00001

3 ... will lead to the Singularity

SCORPION

When Failure is Not an Option

Scientific Approach



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- In a single recursive algorithm
- In raw ANSI C (No MS Libraries)
- With a scalable virtual pointer tree structure

AFRL Sensing Autonomy Vision for NDIA

6 Mar 2018

Terry Wilson, PhD
AFRL/RY
Air Force Research Laboratory

AFRL HERITAGE | 1917–2017

100 YEARS OF U.S. AIR FORCE SCIENCE & TECHNOLOGY

Integrity ★ Service ★ Excellence

RY Autonomy Vision

Autonomy Vision: Timely Generation of knowledge to improve every AF decision

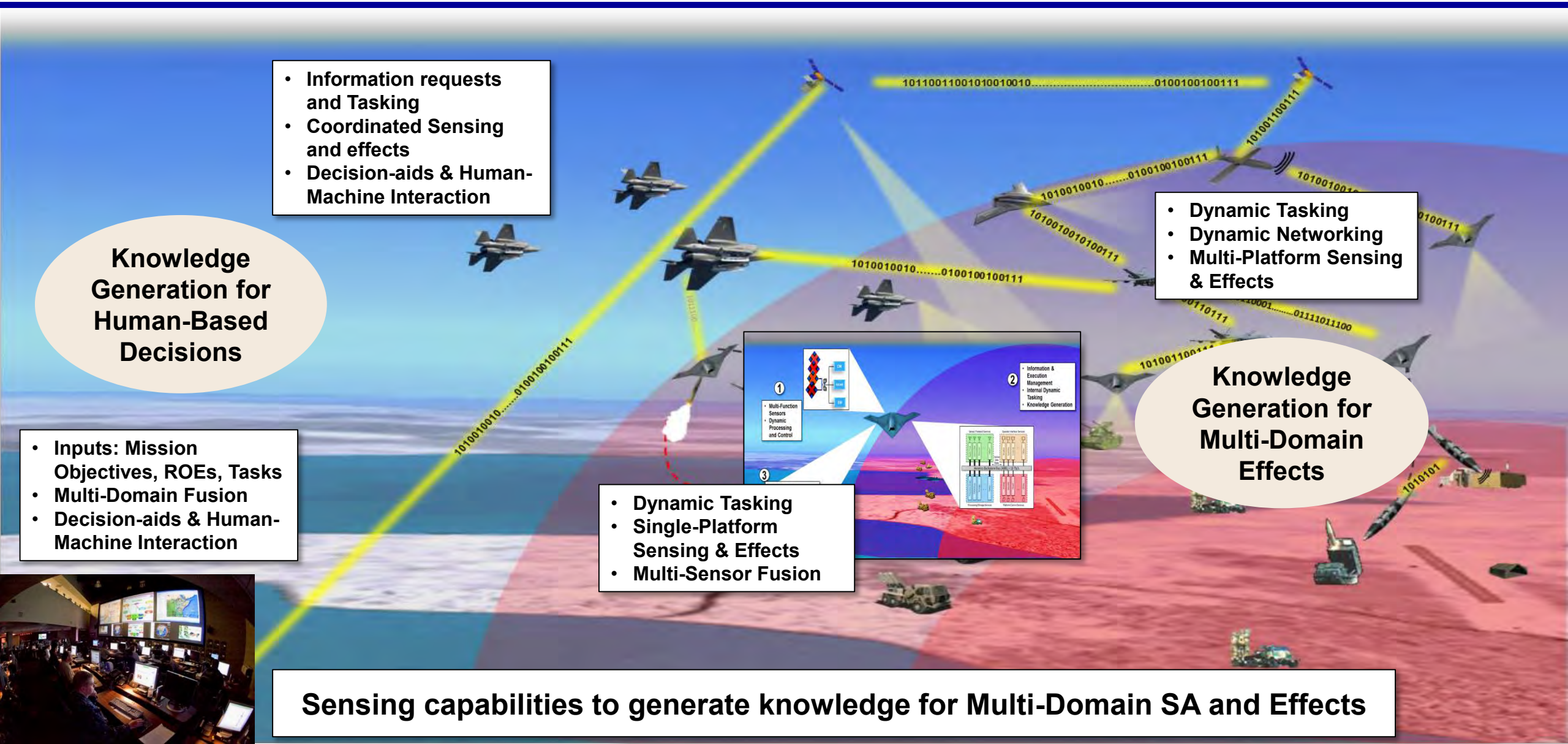
An autonomous sensing system can understand any multi-domain mission environment as a single integrated battlespace through a scalable combination of peer, task, and cognitive flexibilities, executes mission effects, and assesses them in a timely manner.

Flexibility is the key to defense autonomy!

The Need for Change

- **Currently USAF is good at generating knowledge using predefined meaning and specific tasks in a linear fashion**
  - Approach to knowledge generation is manual, slow and not scalable
  - Only a small percentage of the data is used to generate knowledge – limited by manpower
- **Goal of autonomy is to generate knowledge applicable across numerous tasks to break linearity**
  - Provides ability to utilize multi-domain knowledge for faster decisions and actions/effects
  - Applies at all levels of instantiations
- **Defense autonomy application requires flexibility**
  - Cognitive, peer, and task flexibilities

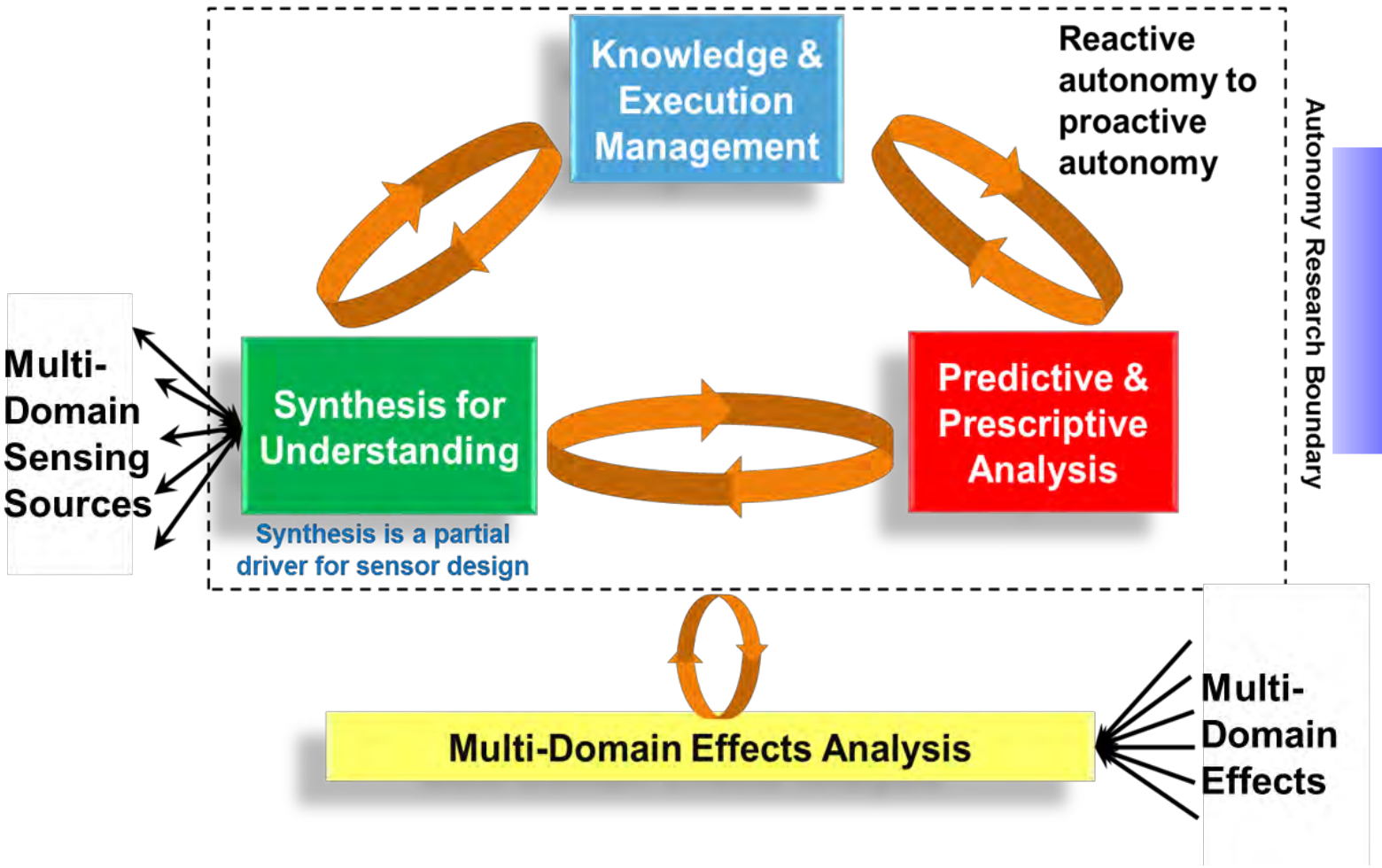
Sensing Autonomy Scenario



Sensing capabilities to generate knowledge for Multi-Domain SA and Effects

RY Autonomy Science Challenges

RY Autonomy Research Thrusts



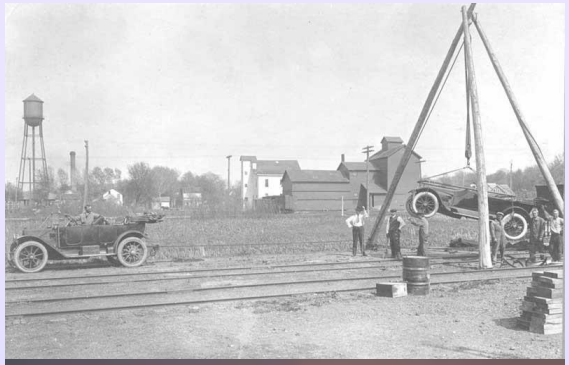
Key Technologies

- Multi-phenomenology level machine learning
- Robust knowledge representation strategies
- Flexible resource management and architecture strategies
- Decision & game theory
- Advanced computing
- Dynamic optimization theory
- Joint inference and control
- Multi-domain constructive MS&A tools
- Cognitive EW

Thank You

Not everyone needs the same tools!

Which are you using?
&
What do you need?



Are you building Skyscrapers
Or
Dog Houses?

A Disruptive Solution to the HPC (Parallel Processing) Problem

Disruptive Solution To HPC (PARALLEL PROCESSING)

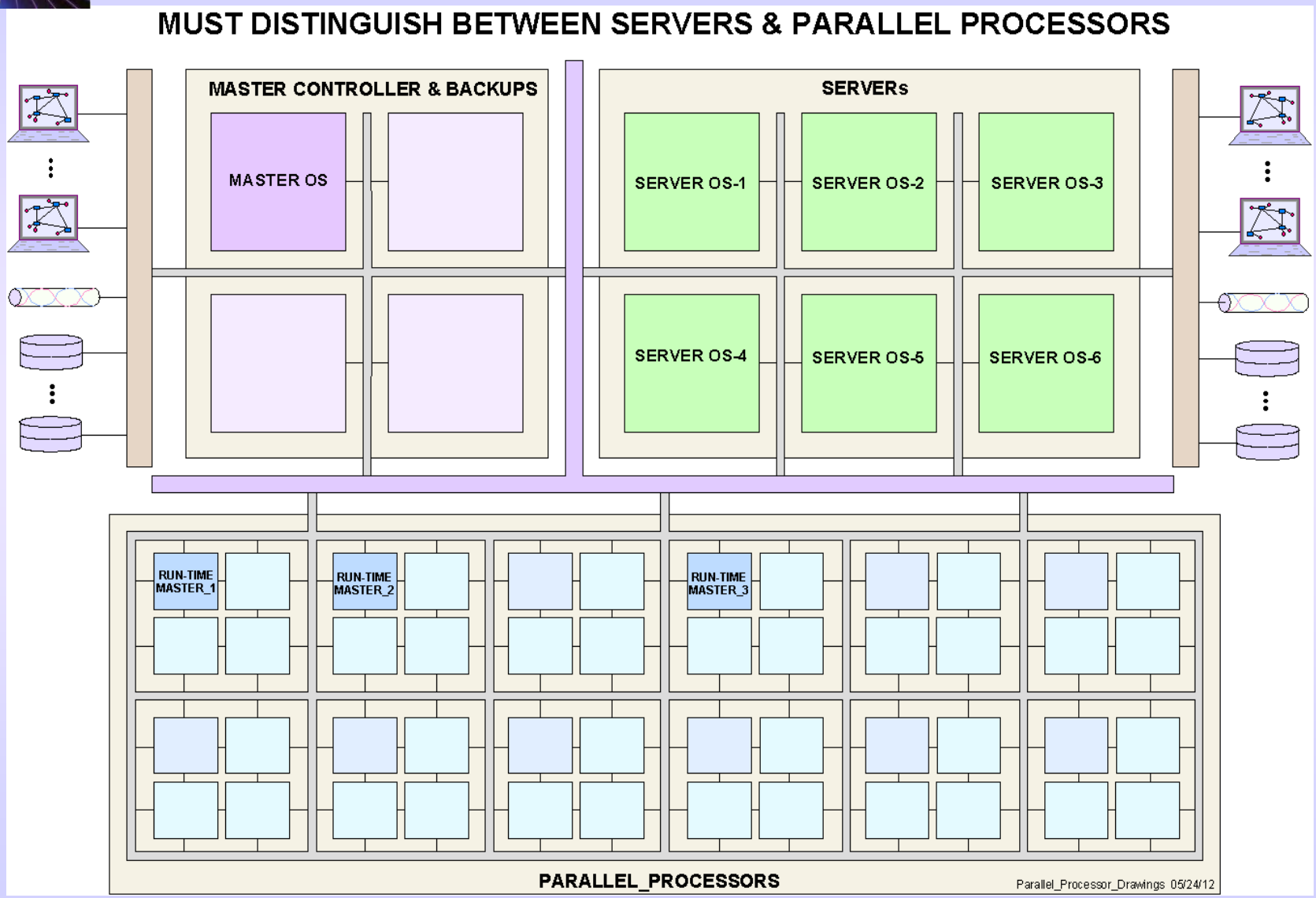
MEASURABLE GOALS:

- **Provide multiple orders of magnitude improvement in application run-time speed;**
- **Provide an order of magnitude reduction in the time and cost to develop software;**
- **Allow application experts to design, build, and test software directly ;**
- **Allow newcomers to a project to quickly learn and understand complex software ;**

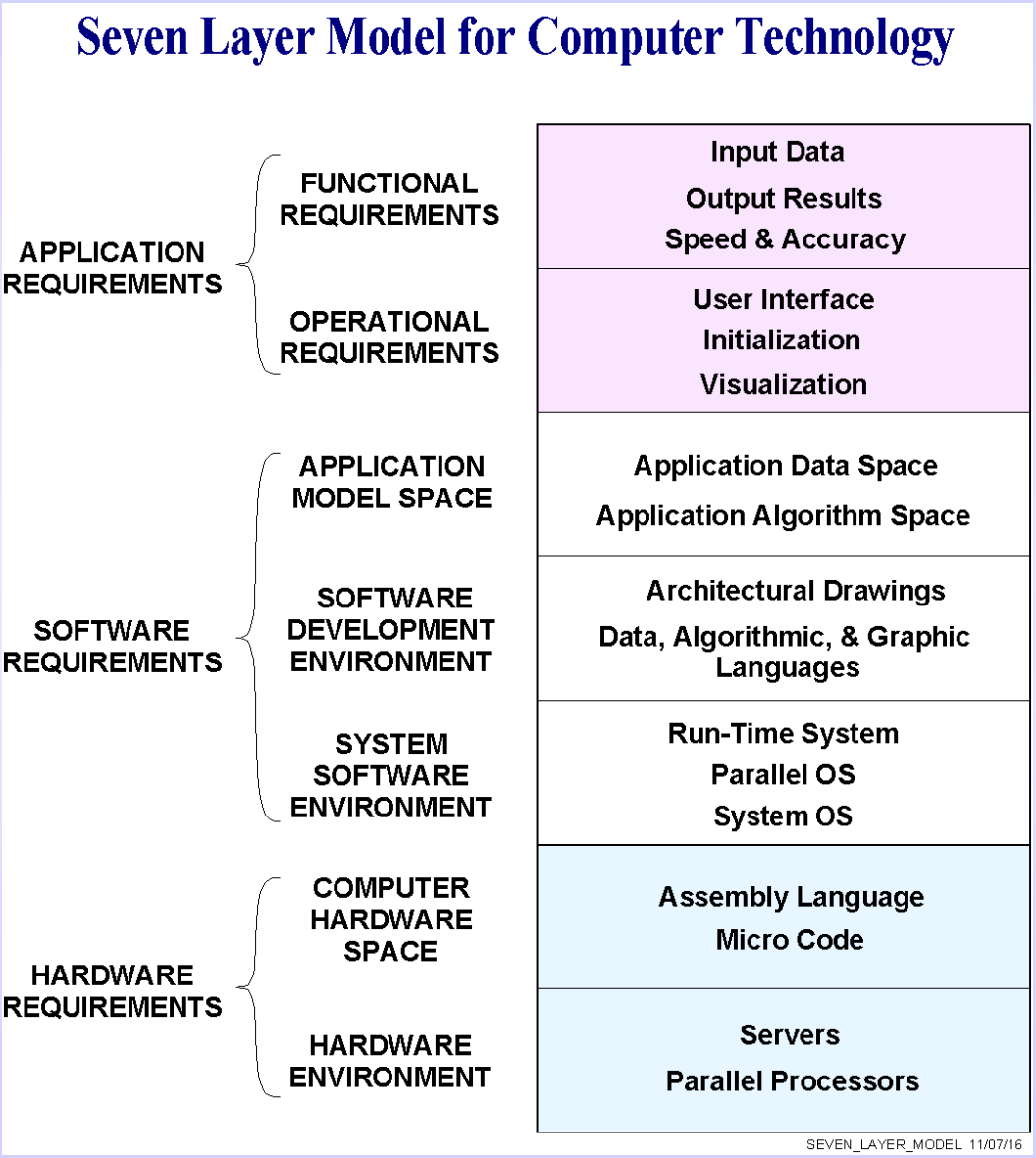
Disruptive Solution To HPC

REPRESENTATIVE APPLICATIONS:

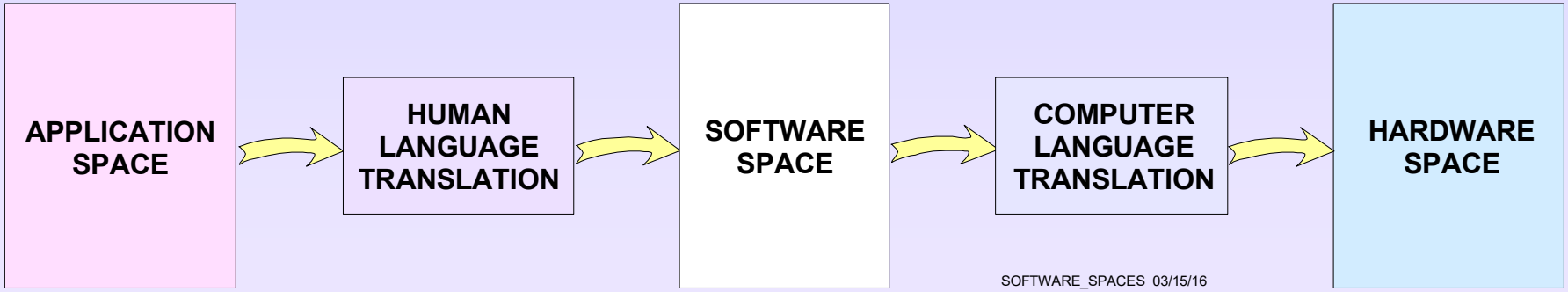
- Adaptive Control of Large Groups of Autonomous Moving Platforms
- Human Body Organ simulation
- Global Climate prediction
- Fluid Flow simulation
- Biological Particle simulation
- Chemical - Molecular structure simulation
- Scanning, sorting, and correlating massive databases (Big Data)
- Weather prediction in mountainous terrain
- Power distribution simulation
- Electro-magnetic wave simulation
- Global HF power transmission
- Global Military Planning - Multiple moving platform simulation


MUST DISTINGUISH BETWEEN SERVERS & PARALLEL PROCESSORS
MASTER CONTROLLER & BACKUPS
MASTER OS
SERVERs
SERVER OS-1
SERVER OS-2
SERVER OS-3
SERVER OS-4
SERVER OS-5
SERVER OS-6
RUN-TIME MASTER_1
RUN-TIME MASTER_2
RUN-TIME MASTER_3
PARALLEL_PROCESSORS
Parallel_Processor_Drawings 05/24/12

Disruptive Solution To HPC

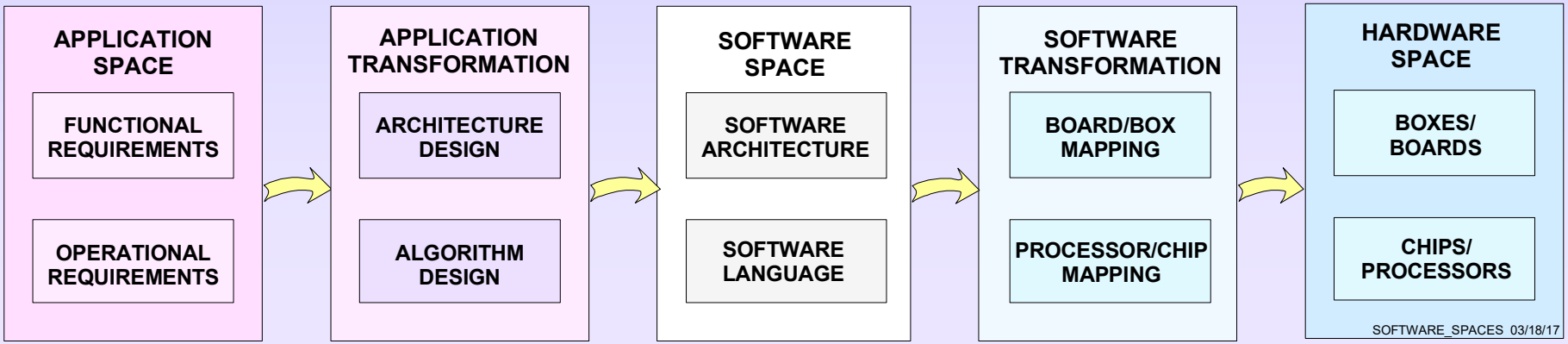


Disruptive Solution To HPC



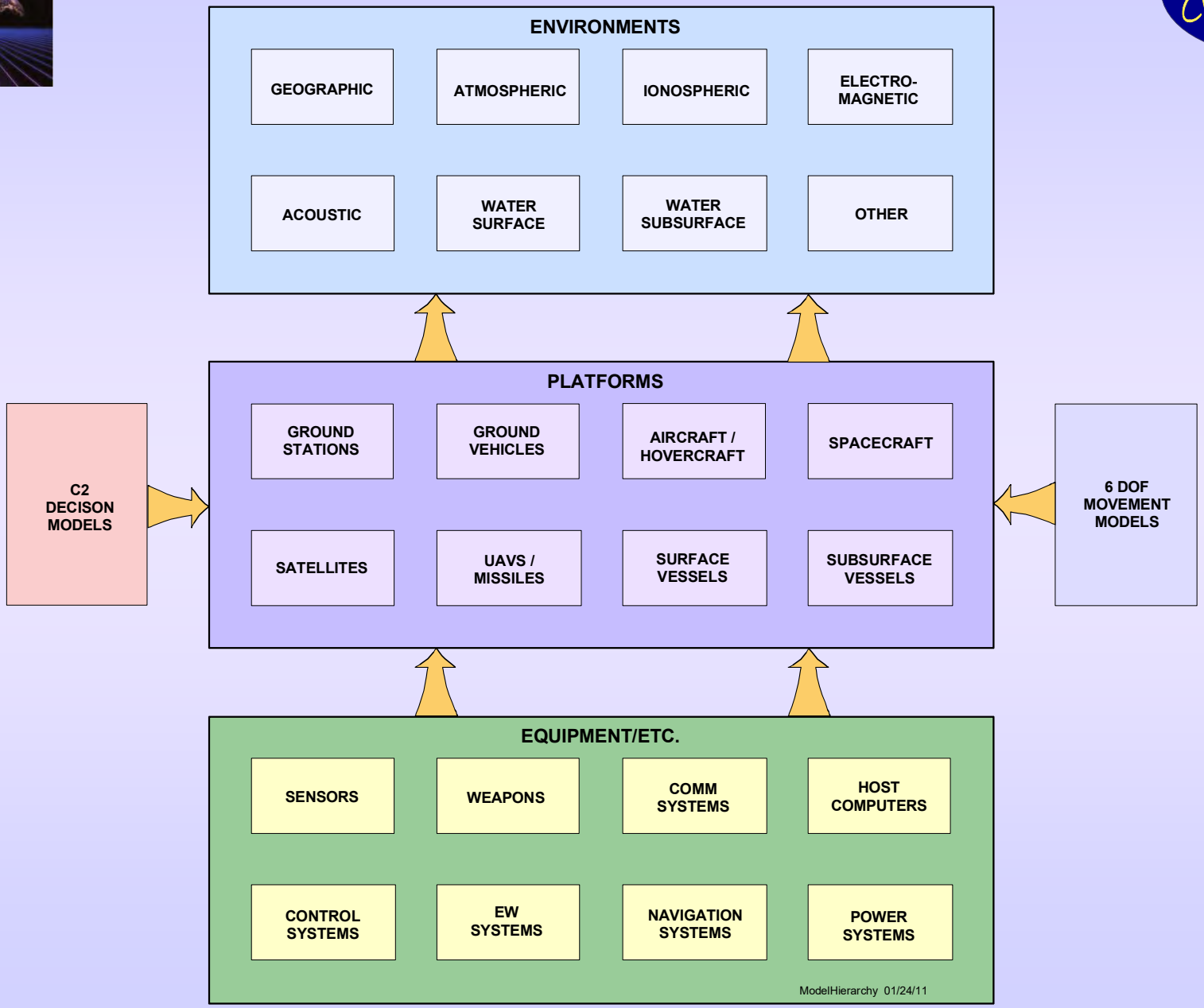
Spaces for Translation of Application Requirements into Software & Hardware

Disruptive Solution To HPC

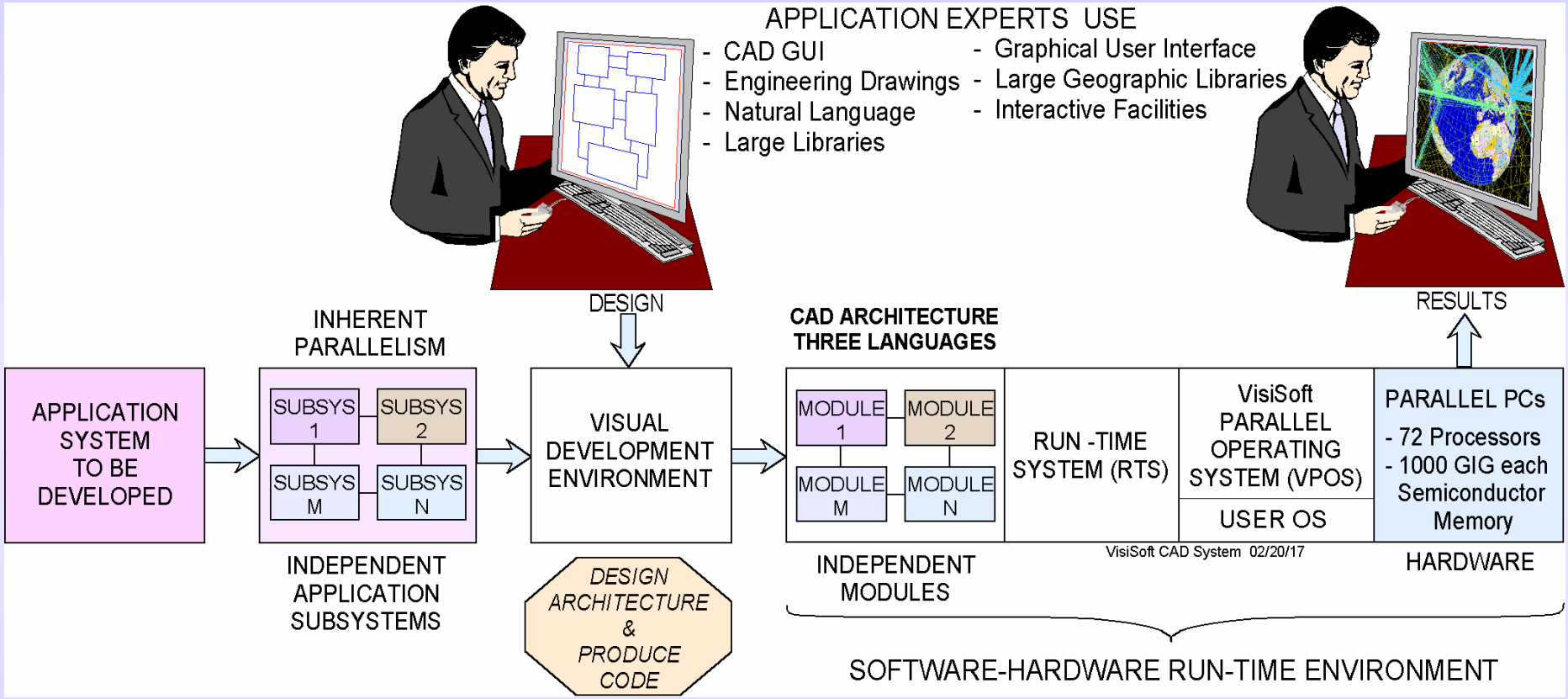


Spaces for Translation of Application Requirements into Software & Hardware

MODEL SPACE HIERARCHY



Disruptive Solution To HPC



Visual Software Engineering Using A CAD System For Building Complex Software

Disruptive Solution To HPC

```
RESOURCE: TRANSCEIVER                    INSTANCES: TRANSMITTER
                                                    RECEIVER

GENERAL_PARAMETERS
     1  TRANSMITTER_POWER            REAL   INITIAL_VALUE 100
     1  RECEIVER_THRESHOLD           REAL   INITIAL_VALUE 120

RADIO
     1  TRANSCEIVER                  STATUS TRANSMITTING
                                            RECEIVING
                                            IDLE
                                            OFF
     1  LOCATION
        2  X_POSITION                REAL
        2  Y_POSITION                REAL
        2  ELEVATION                 REAL
     1  ANTENNA_HEIGHT               REAL
     1  ANTENNA_GAIN                 REAL

RECEIVER_CONNECTIVITY_VECTOR
     1  POWER_AT_RECEIVER            REAL
     1  TOTAL_NOISE_POWER            REAL
     1  CONNECTIVITY_MATRIX
        2  PROPAGATION_LOSSES
           3  TERRAIN_LOSS           REAL
           3  FOLIAGE_LOSS           REAL
           3  TOTAL_LOSS             REAL
        2  SIGNAL_POWER              REAL
        2  SIGNAL_TO_NOISE_RATIO     REAL
        2  LINK_DELAY                REAL
        2  LINK                      STATUS GOOD
                                            FAIR
                                            POOR

TRANSCEIVER_RULES
     1  TRANSCEIVER_PROCESS          RULES  GOOD_RECEPTION
                                            CONFLICTING_RECEPTION
                                            CONFLICTING_BROADCAST
```

A Space - Data Structure (a RESOURCE)

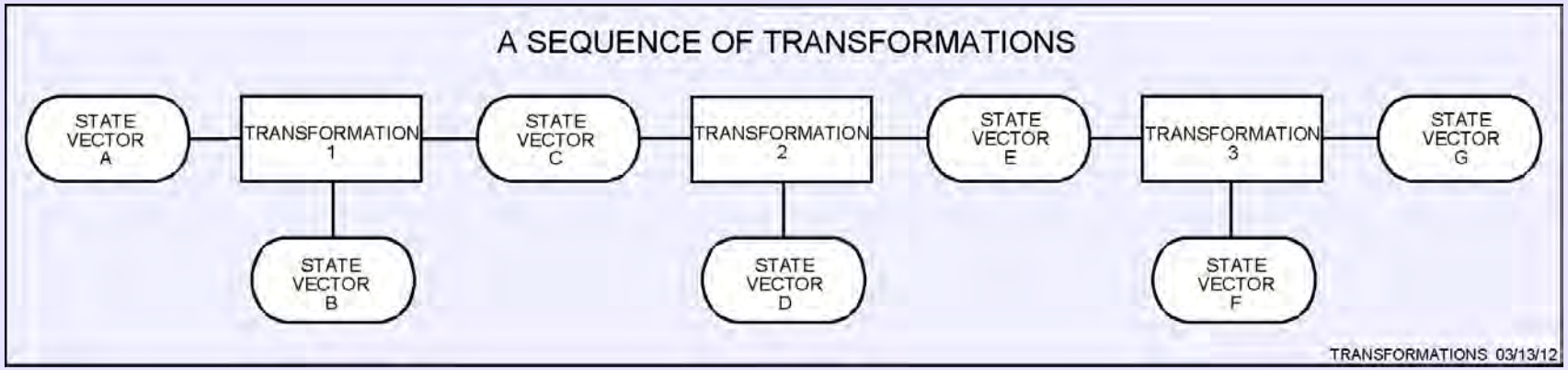
Disruptive Solution To HPC


```
PROCESS: RECEPTION                    RESOURCES: TRANSCEIVER
INSTANCES: TRANSMITTER                           MESSAGE_FORMATS
           RECEIVER                              TRANSMITTER_OUTPUT
```

```
START_RECEPTION
    IF TRANSCEIVER IS IDLE
        EXECUTE GOOD_RECEPTION
    ELSE IF TRANSCEIVER IS RECEIVING
        EXECUTE CONFLICTING_RECEPTION
    ELSE IF TRANSCEIVER IS TRANSMITTING
        EXECUTE CONFLICTING_BROADCAST .

GOOD_RECEPTION
    IF SIGNAL_TO_NOISE_RATIO IS GREATER THAN RECEIVER_THRESHOLD
        SET TRANSCEIVER  TO RECEIVING
        ADD SIGNAL_POWER TO TOTAL POWER_AT_RECEIVER .
        CALL DECODE_MESSAGE .

    IF  MESSAGE TYPE IS FORMAT_A
    AND SYNC_CODE    IS VALID
    AND LAST_SYMBOL  IS A TERMINATOR
         EXECUTE SEND_ACKNOWLEDGEMENT .

CONFLICTING_RECEPTION
    IF POWER_AT_RECEIVER IS GREATER THAN SIGNAL_POWER
        SCHEDULE ABORT_RECEIVE NOW .

CONFLICTING_BROADCAST
    CANCEL END_RECEIVE NOW
    SCHEDULE START_RECEIVE IN EXPON(0.83) MILLISECONDS
        WITH PRIORITY 80

SEND_ACKNOWLEDGEMENT
    MOVE ACKNOWLEDGEMENT TO TRANSMIT_MESSAGE_BUFFER
    IF DESTINATION IS BROADCAST
        SEARCH LINK_CONNECTIVITY_VECTOR OVER RECEIVER
            EXECUTING TRANSMISSION
                WHEN LINK IS GOOD
    ELSE EXECUTE TRANSMISSION .

TRANSMISSION
    SCHEDULE LINK_RECEPTION
        IN LINK_DELAY MICROSECONDS
            USING TRANSMITTER, RECEIVER
```

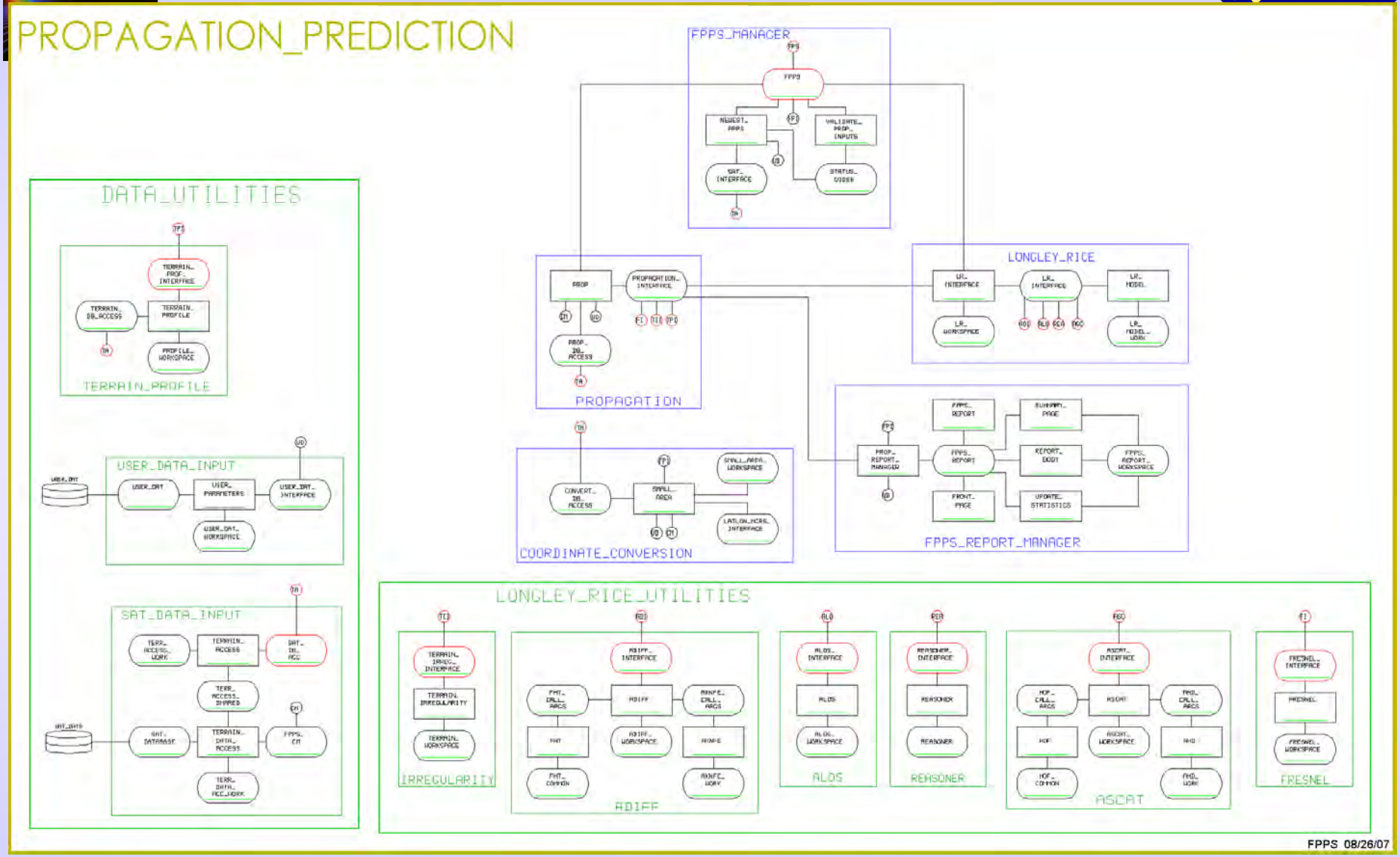
A Transformation - Rule Structure (a PROCESS)

Spaces for Translation of Application Requirements into Software & Hardware



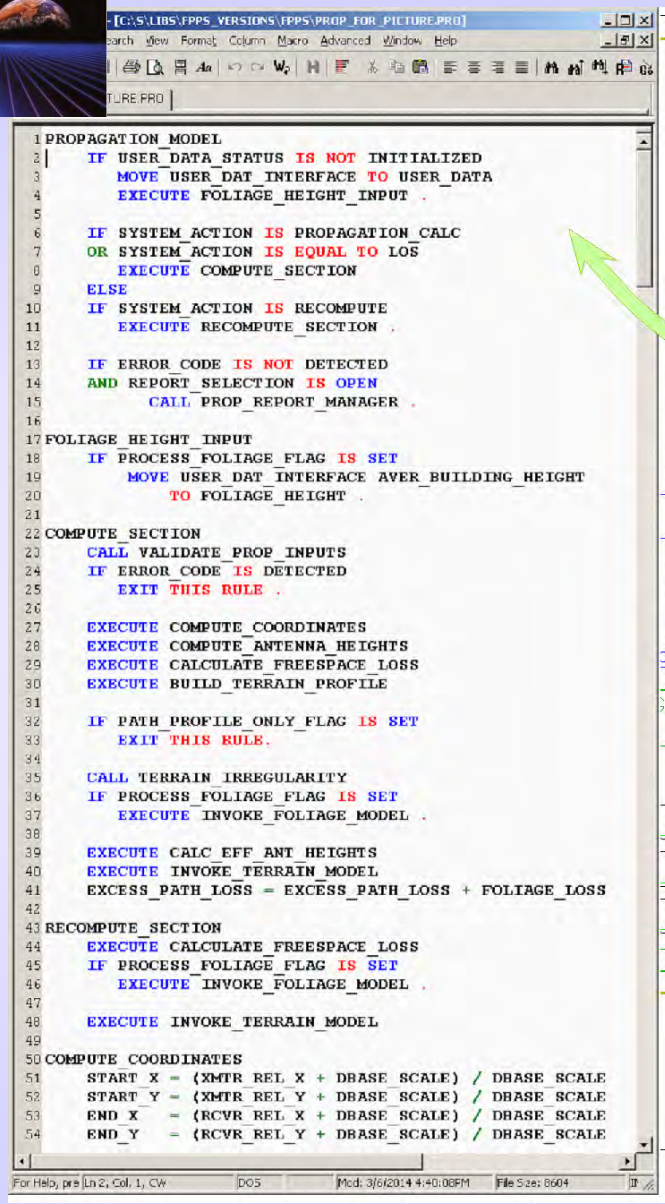
Connecting Resources & Processes to Create a Sequence of Transformations

Disruptive Solution To HPC

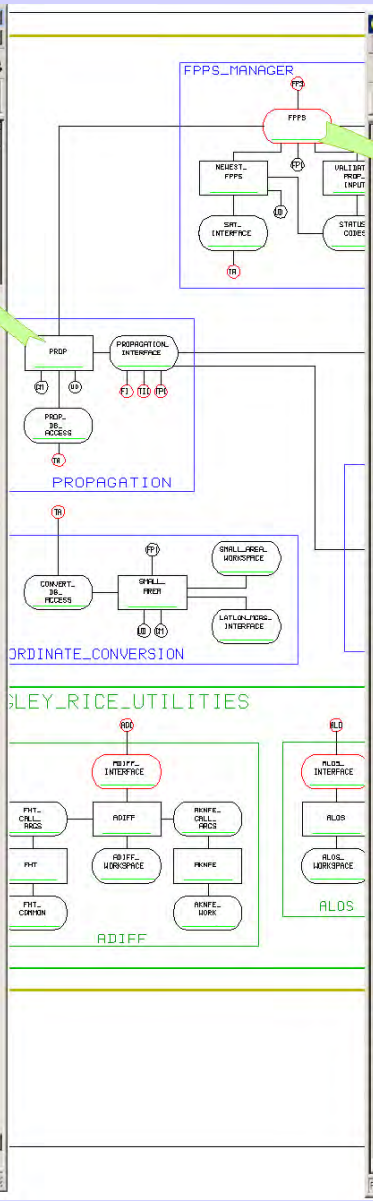


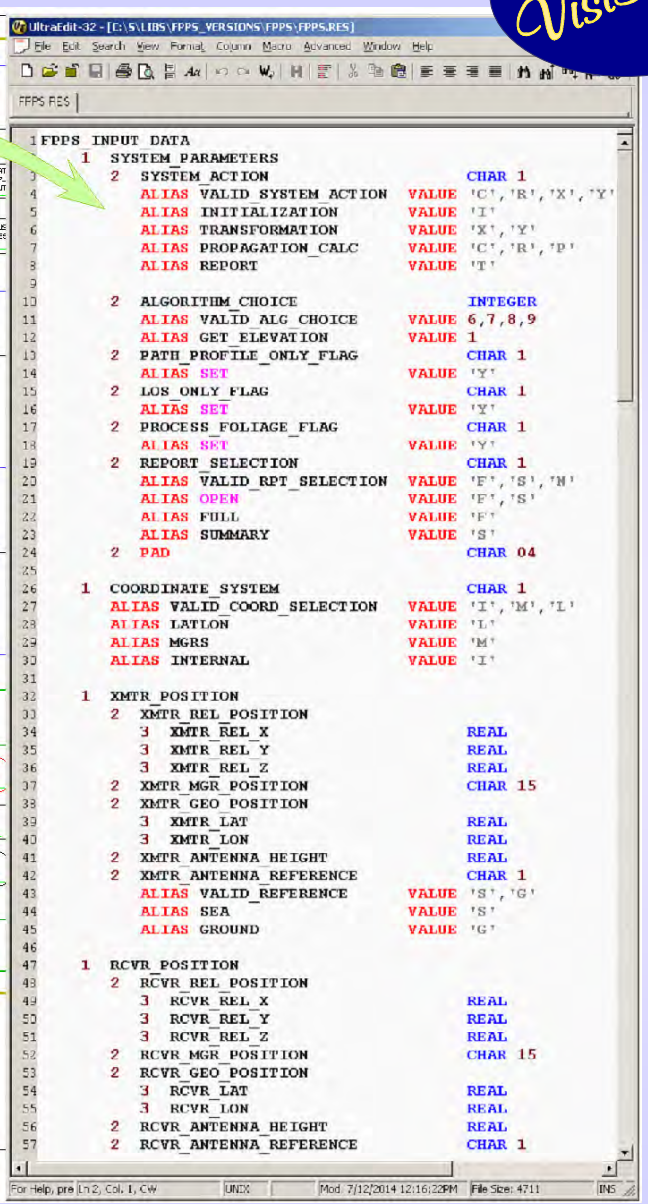
Create a Hierarchy of Software Modules

Disruptive Solution To HPC



```
PROPAGATION_MODEL
    IF USER_DATA_STATUS IS NOT INITIALIZED
       MOVE USER_DAT_INTERFACE TO USER_DATA
       EXECUTE FOLIAGE_HEIGHT_INPUT .

    IF SYSTEM_ACTION IS PROPAGATION_CALC
    OR SYSTEM_ACTION IS EQUAL TO LOS
       EXECUTE COMPUTE_SECTION
    ELSE
    IF SYSTEM_ACTION IS RECOMPUTE
       EXECUTE RECOMPUTE_SECTION .

    IF ERROR_CODE IS NOT DETECTED
    AND REPORT_SELECTION IS OPEN
          CALL PROP_REPORT_MANAGER .

FOLIAGE_HEIGHT_INPUT
    IF PROCESS_FOLIAGE_FLAG IS SET
        MOVE USER_DAT_INTERFACE AVER_BUILDING_HEIGHT
           TO FOLIAGE_HEIGHT .

COMPUTE_SECTION
    CALL VALIDATE_PROP_INPUTS
    IF ERROR_CODE IS DETECTED
       EXIT THIS RULE .

    EXECUTE COMPUTE_COORDINATES
    EXECUTE COMPUTE_ANTENNA_HEIGHTS
    EXECUTE CALCULATE_FREESPACE_LOSS
    EXECUTE BUILD_TERRAIN_PROFILE

    IF PATH_PROFILE_ONLY_FLAG IS SET
       EXIT THIS RULE.

    CALL TERRAIN_IRREGULARITY
    IF PROCESS_FOLIAGE_FLAG IS SET
       EXECUTE INVOKE_FOLIAGE_MODEL .

    EXECUTE CALC_EFF_ANT_HEIGHTS
    EXECUTE INVOKE_TERRAIN_MODEL
    EXCESS_PATH_LOSS = EXCESS_PATH_LOSS + FOLIAGE_LOSS

RECOMPUTE_SECTION
    EXECUTE CALCULATE_FREESPACE_LOSS
    IF PROCESS_FOLIAGE_FLAG IS SET
       EXECUTE INVOKE_FOLIAGE_MODEL .

    EXECUTE INVOKE_TERRAIN_MODEL

COMPUTE_COORDINATES
    START_X = (XMTR_REL_X + DBASE_SCALE) / DBASE_SCALE
    START_Y = (XMTR_REL_Y + DBASE_SCALE) / DBASE_SCALE
    END_X   = (RCVR_REL_X + DBASE_SCALE) / DBASE_SCALE
    END_Y   = (RCVR_REL_Y + DBASE_SCALE) / DBASE_SCALE
```



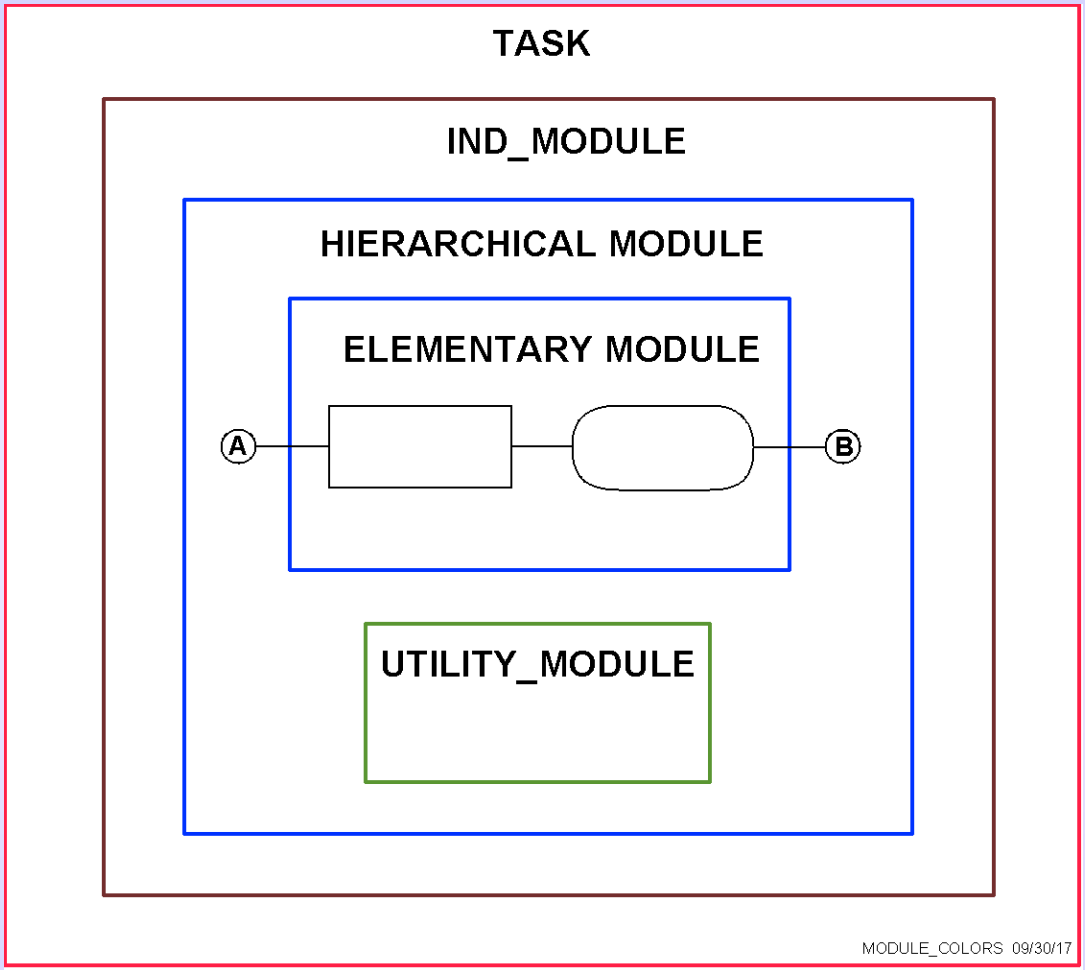


```
FPPS_INPUT_DATA
  1  SYSTEM_PARAMETERS
     2  SYSTEM_ACTION                    CHAR 1
        ALIAS VALID_SYSTEM_ACTION   VALUE 'C','R','X','Y'
        ALIAS INITIALIZATION        VALUE 'I'
        ALIAS TRANSFORMATION        VALUE 'X','Y'
        ALIAS PROPAGATION_CALC      VALUE 'C','R','P'
        ALIAS REPORT                VALUE 'T'

     2  ALGORITHM_CHOICE                 INTEGER
        ALIAS VALID_ALG_CHOICE      VALUE 6,7,8,9
        ALIAS GET_ELEVATION         VALUE 1
     2  PATH_PROFILE_ONLY_FLAG           CHAR 1
        ALIAS SET                   VALUE 'Y'
     2  LOS_ONLY_FLAG                    CHAR 1
        ALIAS SET                   VALUE 'Y'
     2  PROCESS_FOLIAGE_FLAG             CHAR 1
        ALIAS SET                   VALUE 'Y'
     2  REPORT_SELECTION                 CHAR 1
        ALIAS VALID_RPT_SELECTION   VALUE 'F','S','N'
        ALIAS OPEN                  VALUE 'F','S'
        ALIAS FULL                  VALUE 'F'
        ALIAS SUMMARY               VALUE 'S'
     2  PAD                              CHAR 04

  1  COORDINATE_SYSTEM                   CHAR 1
     ALIAS VALID_COORD_SELECTION    VALUE 'I','M','L'
     ALIAS LATLON                   VALUE 'L'
     ALIAS MGRS                     VALUE 'M'
     ALIAS INTERNAL                 VALUE 'I'

  1  XMTR_POSITION
     2  XMTR_REL_POSITION
        3  XMTR_REL_X                    REAL
        3  XMTR_REL_Y                    REAL
        3  XMTR_REL_Z                    REAL
     2  XMTR_MGR_POSITION                CHAR 15
     2  XMTR_GEO_POSITION
        3  XMTR_LAT                      REAL
        3  XMTR_LON                      REAL
     2  XMTR_ANTENNA_HEIGHT              REAL
     2  XMTR_ANTENNA_REFERENCE           CHAR 1
        ALIAS VALID_REFERENCE       VALUE 'S','G'
        ALIAS SEA                   VALUE 'S'
        ALIAS GROUND                VALUE 'G'

  1  RCVR_POSITION
     2  RCVR_REL_POSITION
        3  RCVR_REL_X                    REAL
        3  RCVR_REL_Y                    REAL
        3  RCVR_REL_Z                    REAL
     2  RCVR_MGR_POSITION                CHAR 15
     2  RCVR_GEO_POSITION
        3  RCVR_LAT                      REAL
        3  RCVR_LON                      REAL
     2  RCVR_ANTENNA_HEIGHT              REAL
     2  RCVR_ANTENNA_REFERENCE           CHAR 1
```

Double Click To Edit The Code

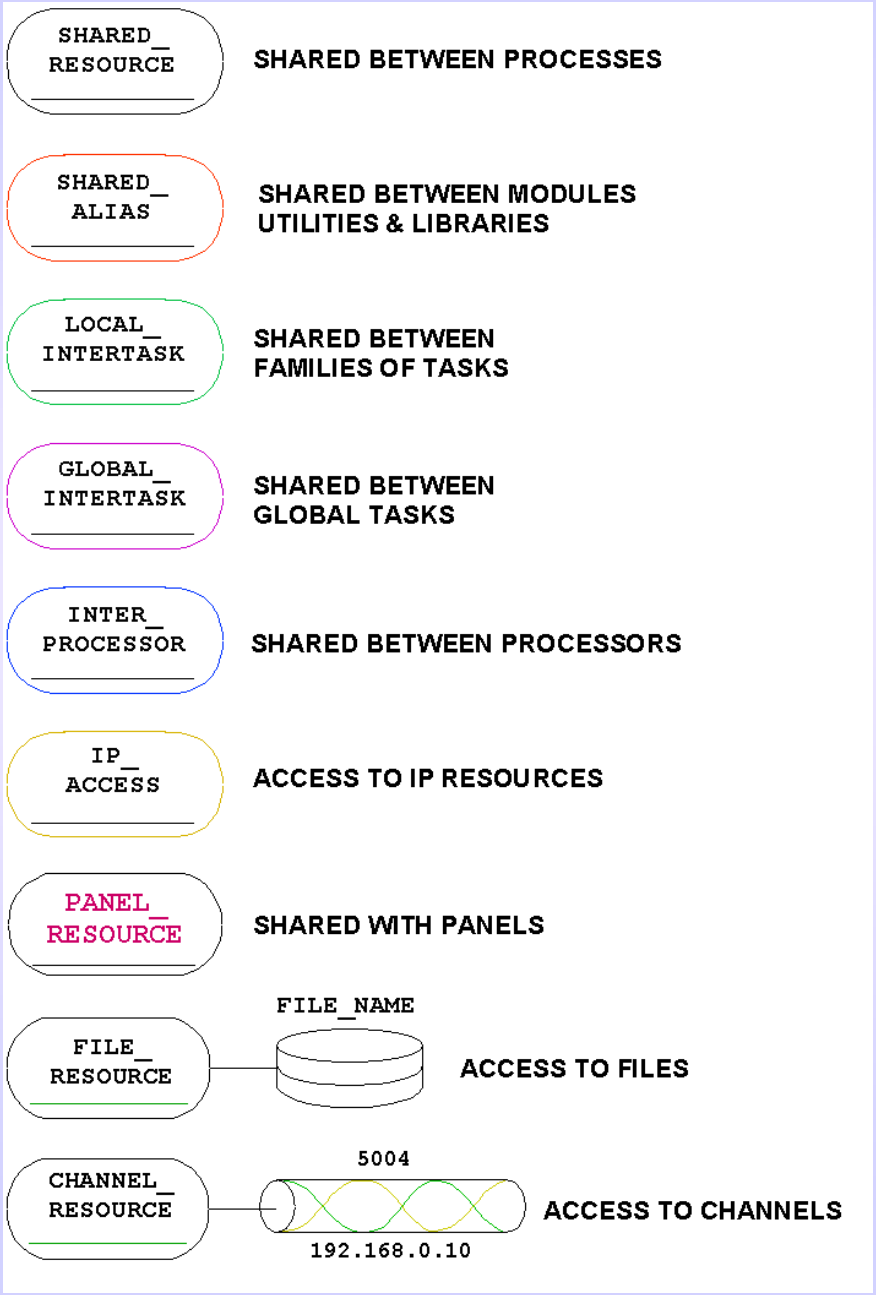
Disruptive Solution To HPC

TYPES OF MODULES

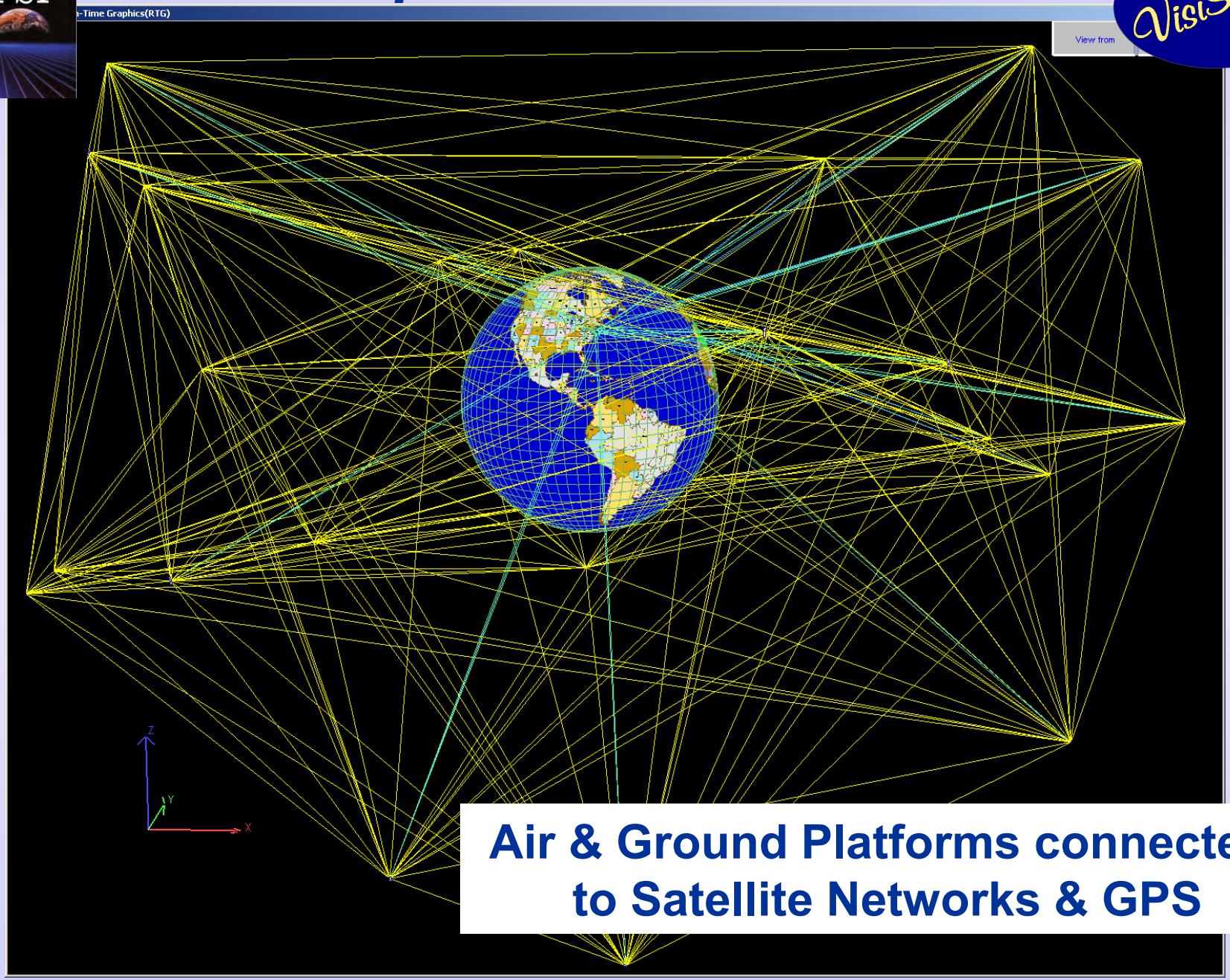


Disruptive Solution To HPC

TYPES OF RESOURCES

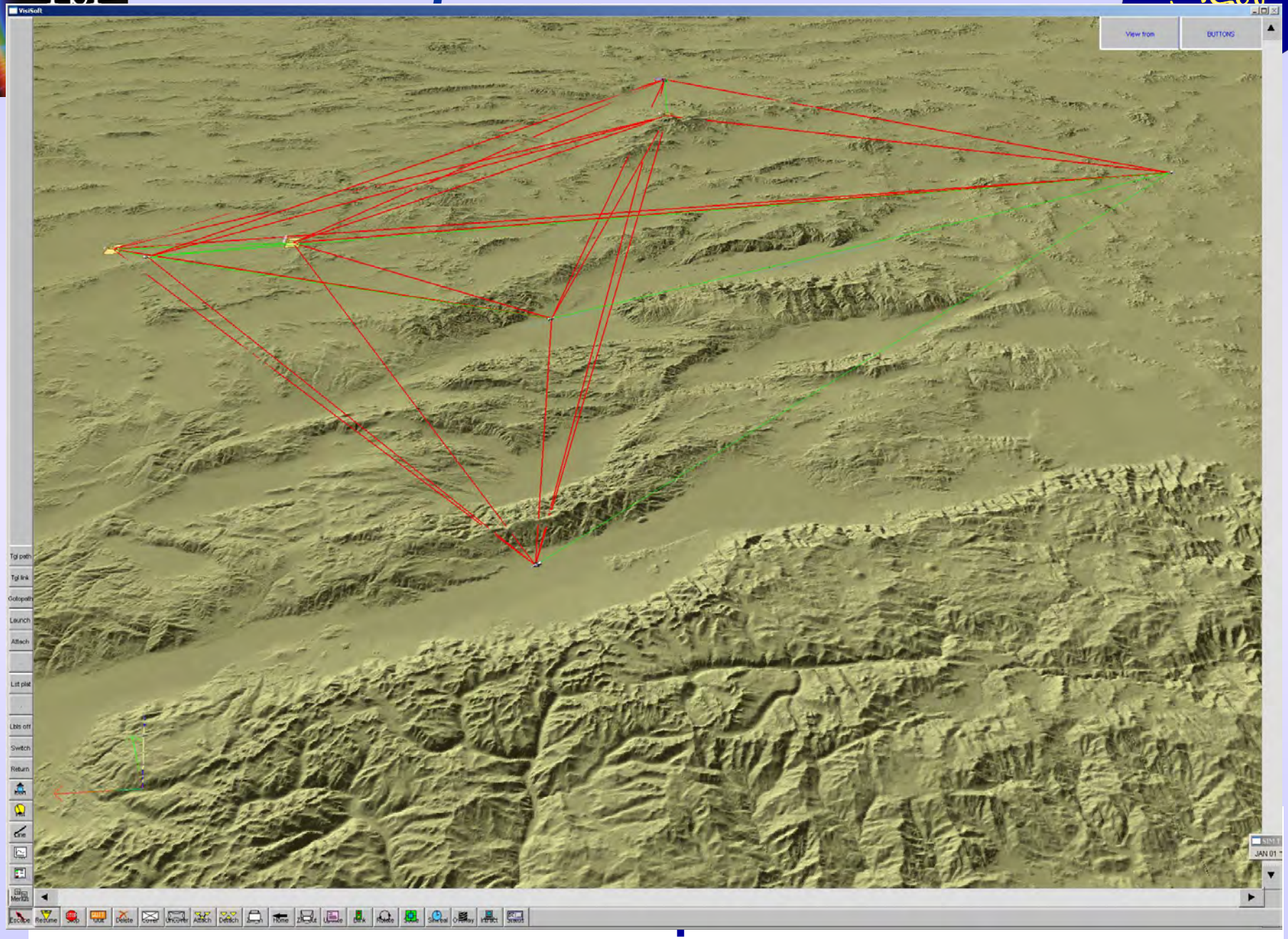


Disruptive Solution To HPC

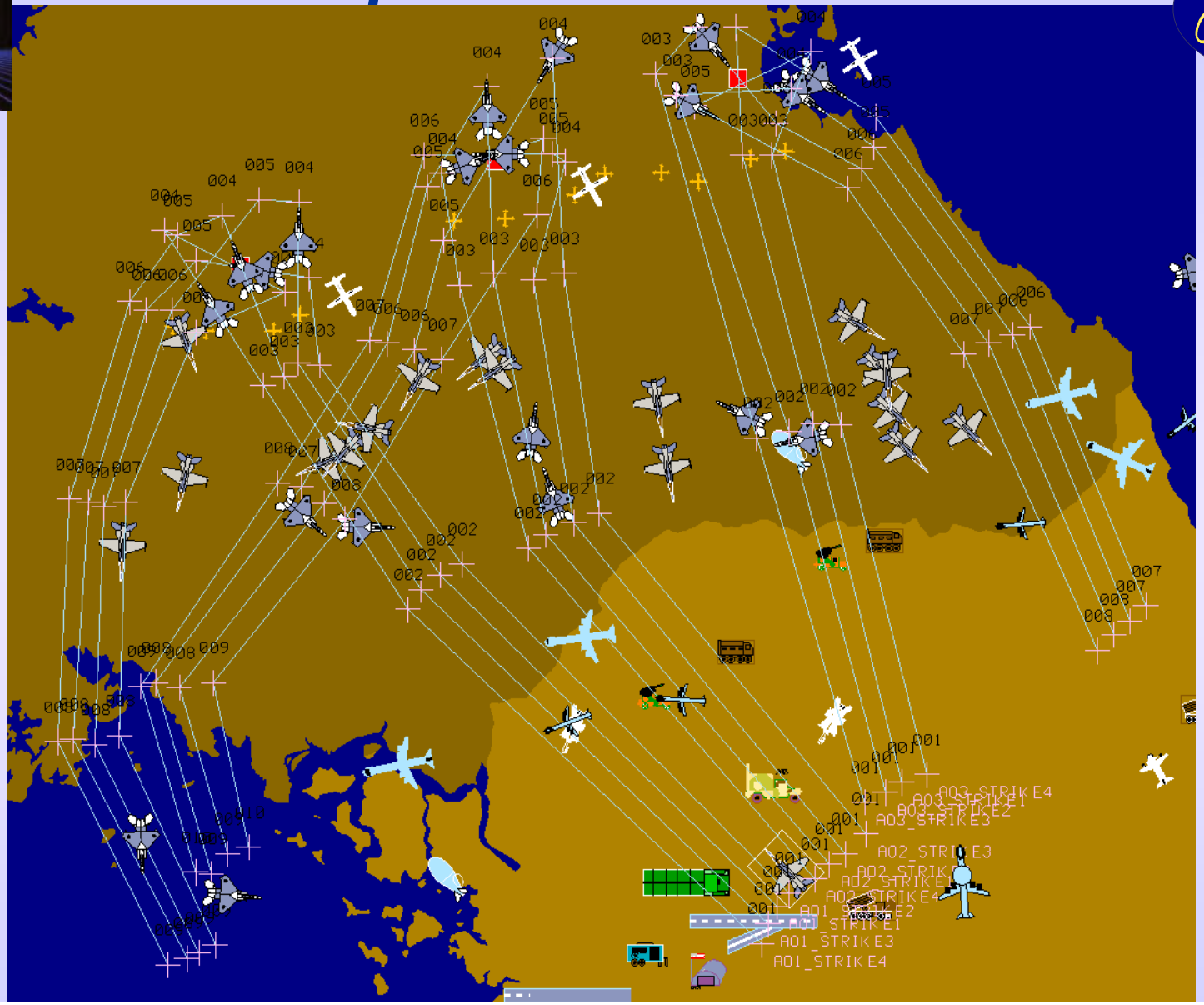


Air & Ground Platforms connected to Satellite Networks & GPS

Disruptive Solution To HPC

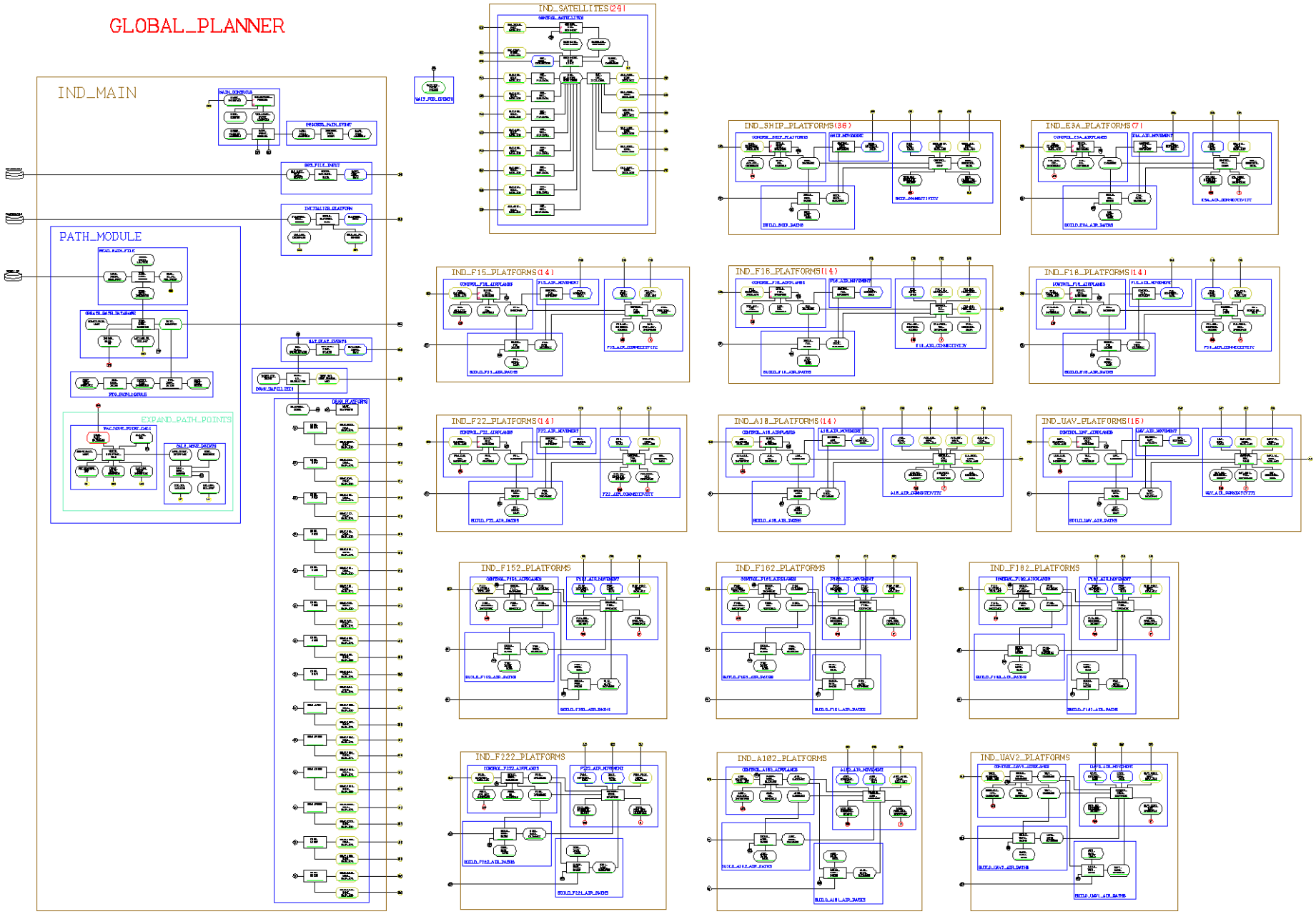


Disruptive Solution To HPC



Must be able to *create* complex scenarios - fast!

Disruptive Solution To HPC



If you use VisiSoft to build complex

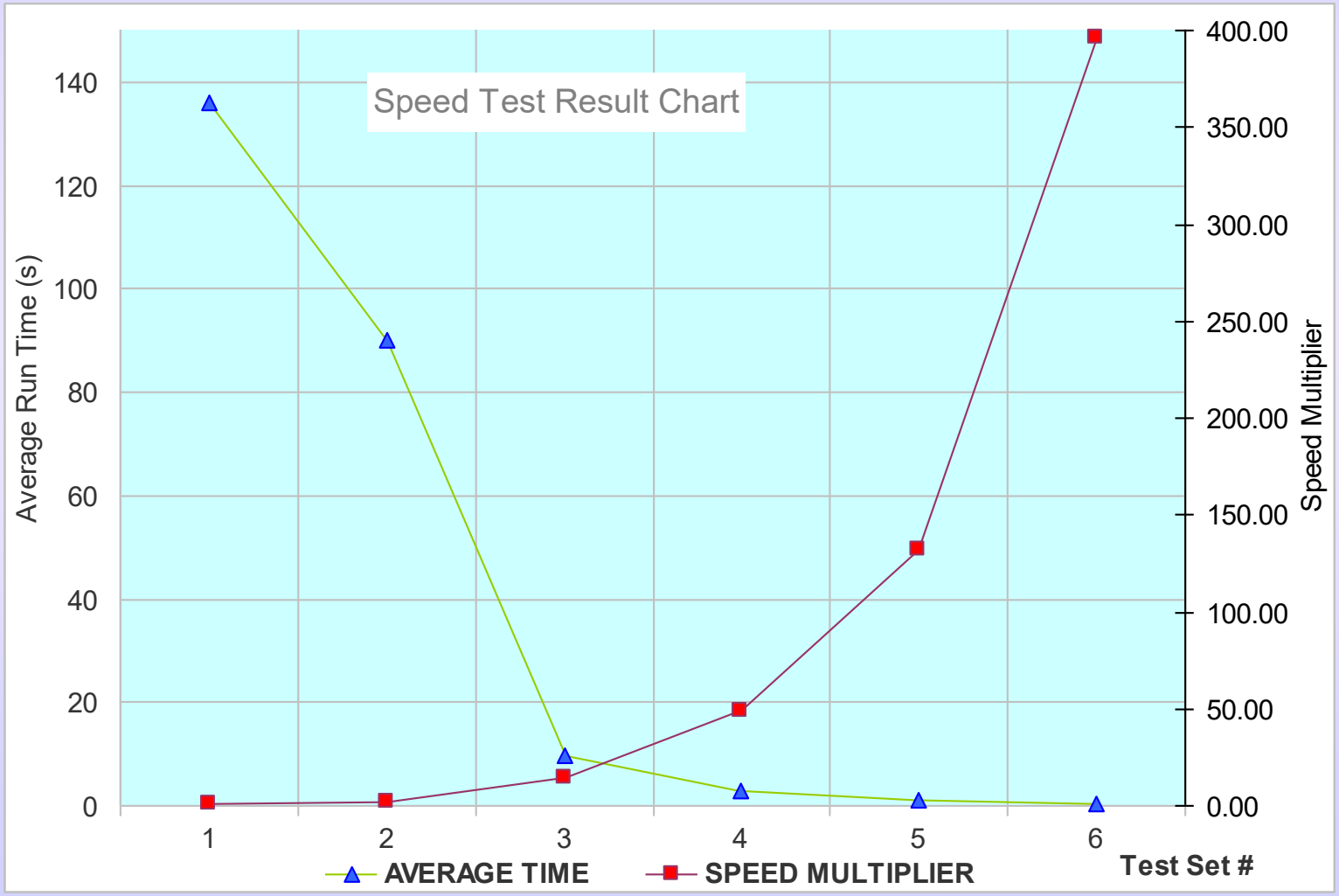
Real-Time Control Systems & Simulations

on Parallel Processors

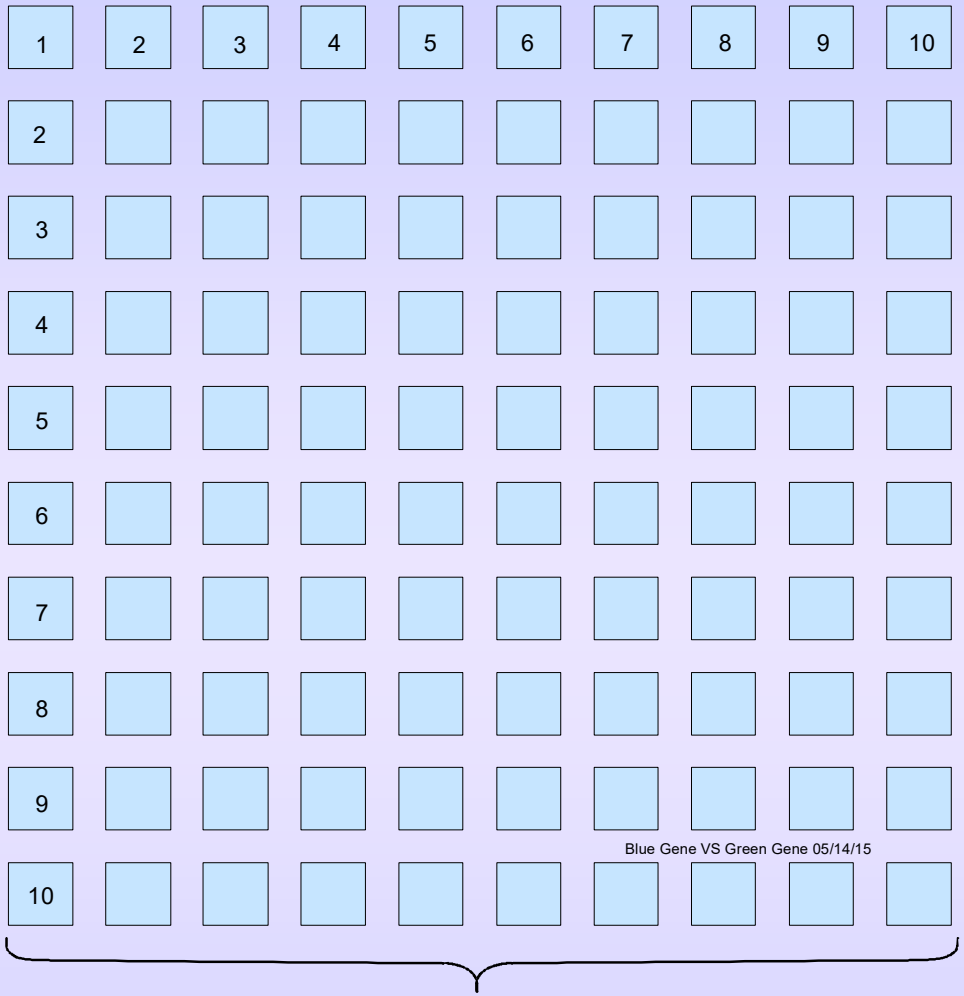
you can save many orders of magnitude

of time and money!

SINGLE PROCESSOR SPEED COMPARISONS - GAIN 100+ X SPEED WITH VISISOFT PRINCIPLES



GO FROM 100 RACKS TO 1 RACK



The IBM Blue Gene - Using Standard Languages - 100 Racks - 1,638,400 Processors
5,000 Sq Ft. - 8,000 KW

Versus

The Green Gene Machine - Using VisiSoft - 1 Rack - 2300 Processors
16 Sq Ft. - 32 KW

What does that do to memory boundary crossing delays?

What about 1 to 2 additional orders of magnitude?

It doesn't stop there!

We can shrink it more
with our architectural drawings of software!

What about a total of 4 to 6
orders of magnitude?

Know what that does to energy utilization?

And, it doesn't stop there!

We can shrink it even more – using our hierarchical data structures to support fast heterogeneous models (time & space).

What about a total of 6 to 8 orders of magnitude* ?

Know what that does to the computer field?

****Depends on the application***

It still doesn't stop there!

We can make it even faster!

Separate Parallel Processor design from Server design.

Get rid of DMA Channel Comm-Routing

And use Direct Memory Access between PC boxes.

And still - not finally,

Use VPOS - a tailored
Parallel Processing OS.

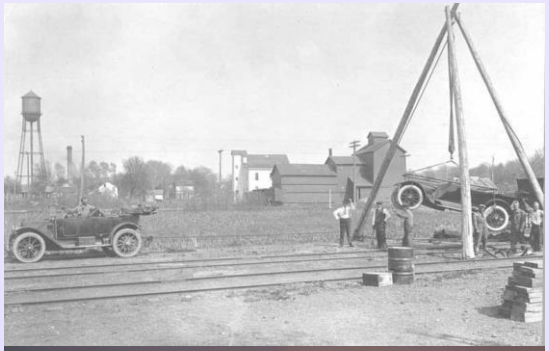
And get rid of big time wasters, e.g.:
- Cache Coherency
- Thread Synchronization
- Stacks
- Etc.

Improving Speed to get Accuracy

REVIEW OF HOW THIS LEVEL OF SPEED IS ACHIEVED

- VisiSoft SINGLE PROCESSOR SPEEDS vs C++, …, Fortran
  - Gain 2+ Orders of magnitude (already tested)
- CAN MATCH 100 RACKS WITH 1 RACK
  - Gain 2+ Orders of magnitude (obvious distances/comm)
- VisiSoft PARALLEL PROCESSOR SPEEDS
  - Gain ≈ 2 Orders of magnitude (includes PUE - already tested)
- USE HETEROGENEOUS CELL SIZES
  - Gain ≈ 1 Order of magnitude (already tested)
- USE HETEROGENEOUS TIME STEPS
  - Gain ≈ 1 Order of magnitude (already tested)

VisiSoft - CAN BEAT REAL SPEED REQUIREMENTS BY
- 6 TO 8 ORDERS OF MAGNITIDE - ON PARALLEL PROCESSORS



Not everyone needs the same tools!

PREDICTION SYSTEMS, INC.

Visual Software International

309 Morris Ave Suite J
Spring Lake, NJ 07762

Telephone: (732) 449-6800
Fax: (732) 449-0897

Web Sites: www.VisiSoft.com
www.predictsys.com

E-Mail VSI@VisiSoft.com

Disruptive Solution To HPC

QUESTIONS

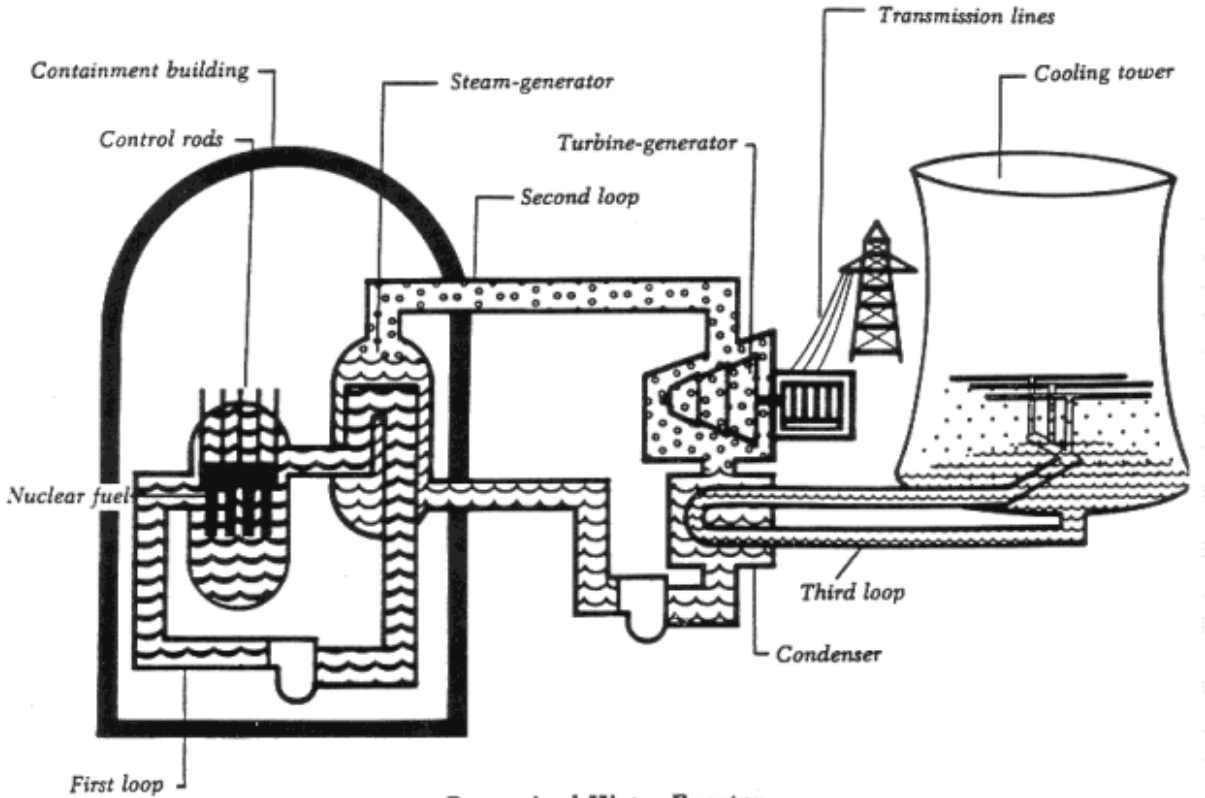
Functional Monitoring & Diagnosis (FMD)

John J Kelly, PhD
Model Software Corporation
www.ModelSoftware.com

Model Software

Vision

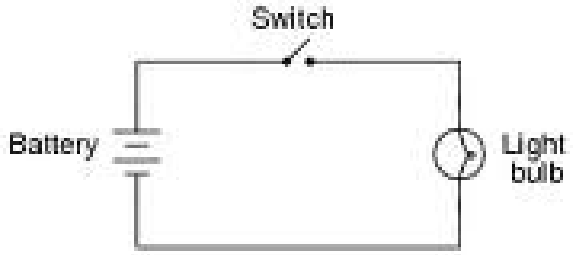
- Monitor and diagnose any plant in real time based on an operational model of the plant



Pressurized Water Reactor

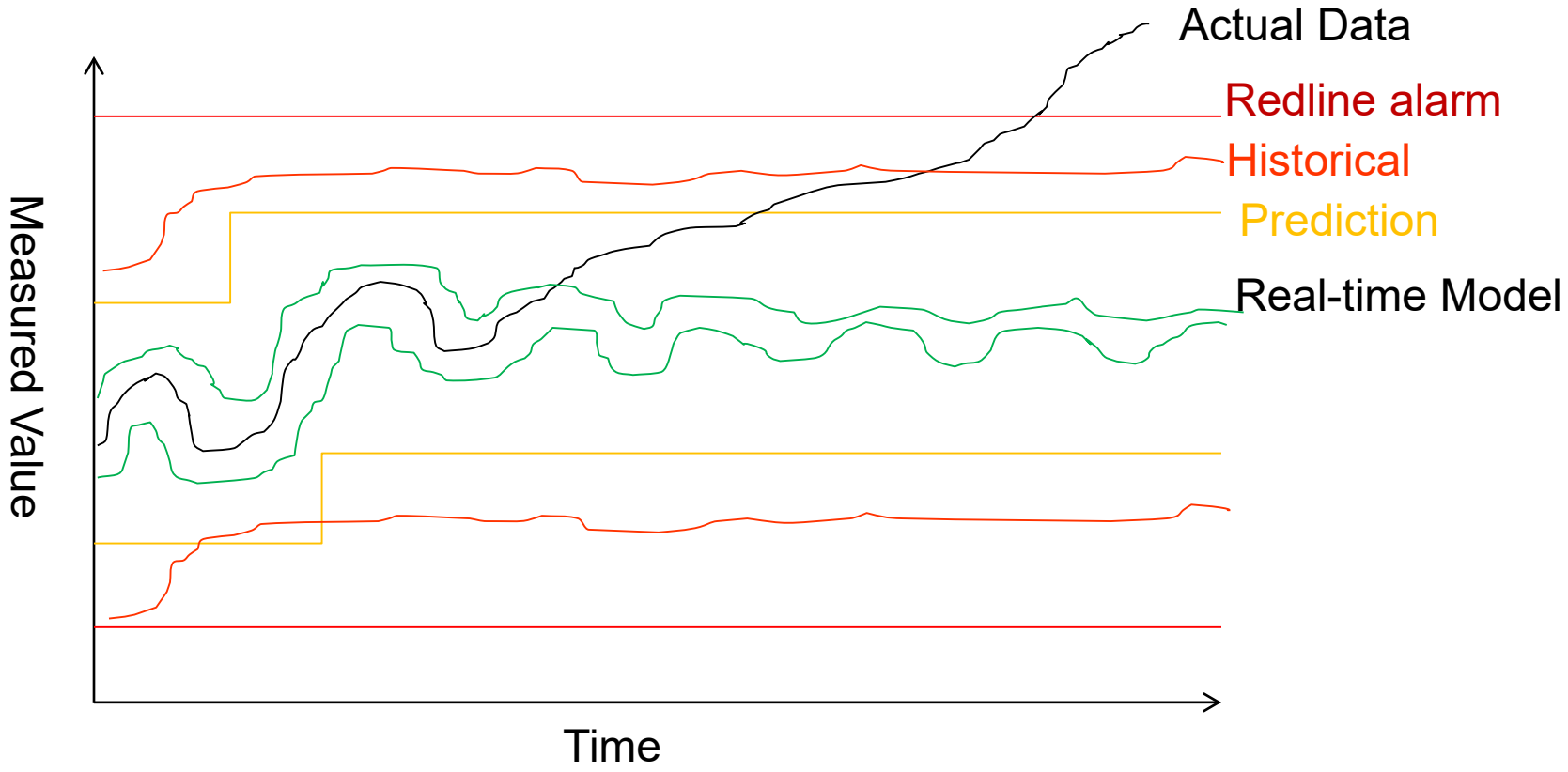
Model Software

Simplified Example: System & Model



Luminance = c * Power
Power = Voltage * Current
Voltage = Current *Resistance
Resistance = {if S=closed, R1}
{if S=open, ~infinite}
R1 = {if bulb=nominal, 1 ohm}
Voltage = {if battery=nominal, 1.5 volts}

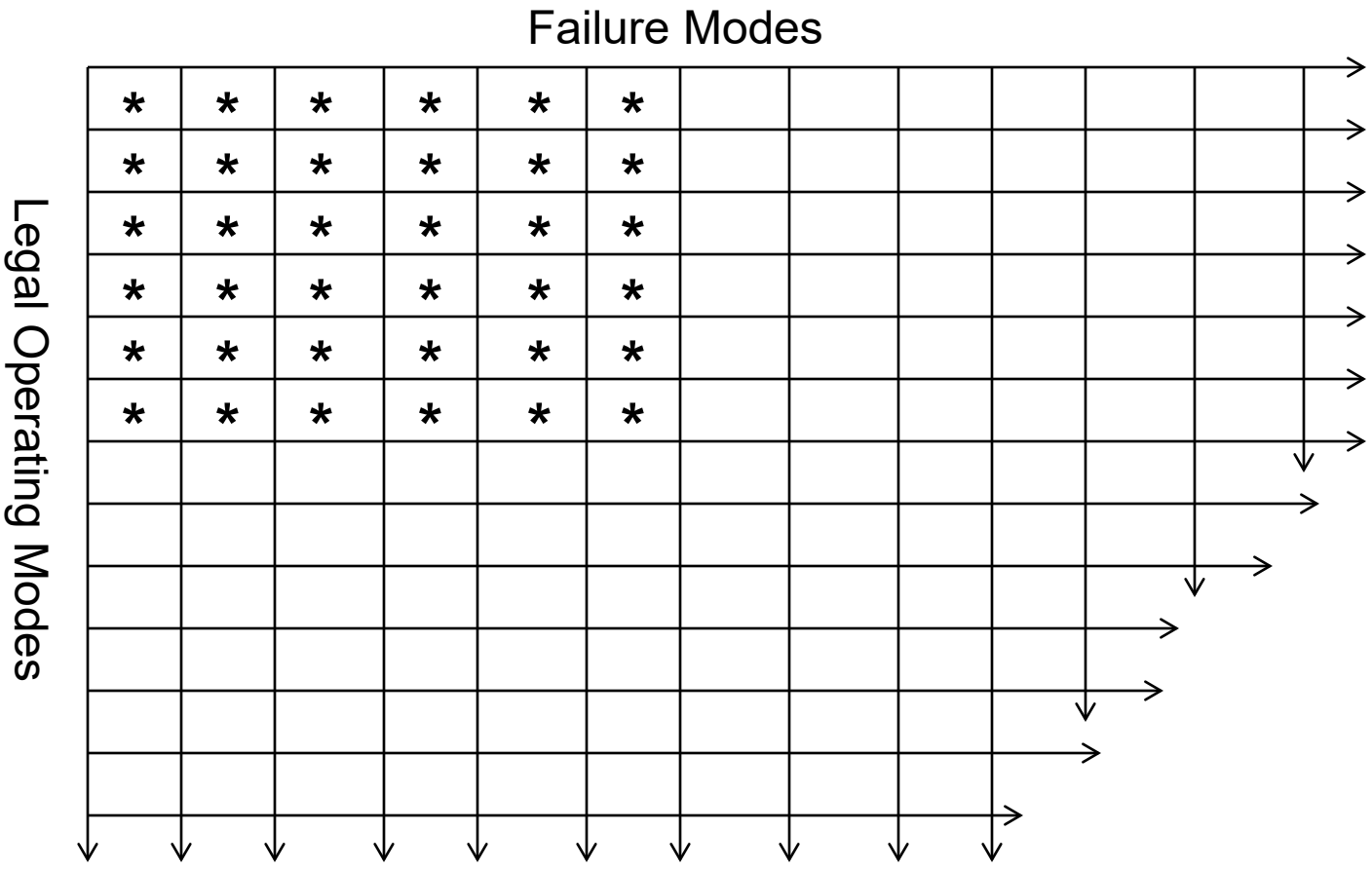
Real-time Detection of Failure



• Using an operating model enables detecting failures earlier than they might otherwise be detected, affording more time to manage them

Model Software

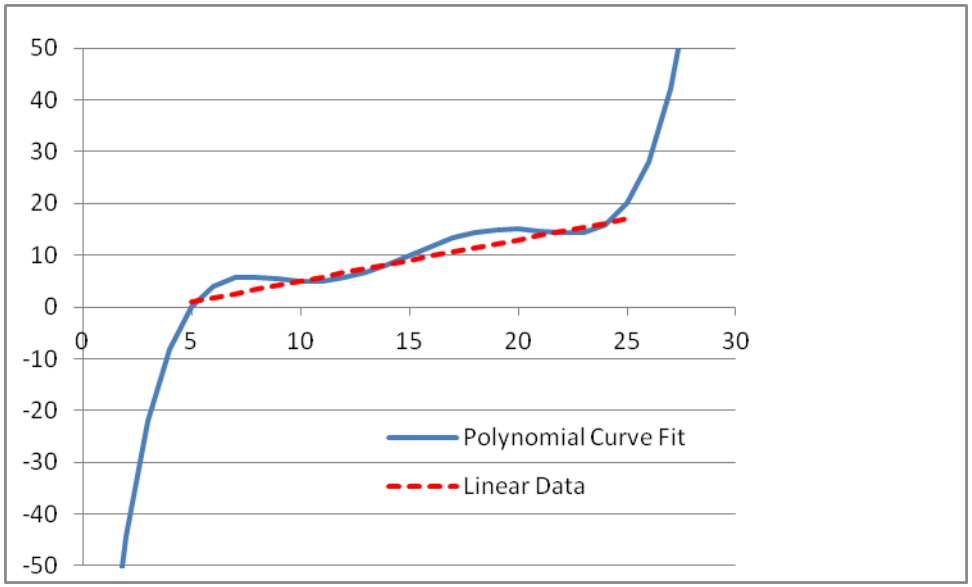
Combinatorial Space of Symptoms



* Defined symptom-fault relation

Model Software

Existing Technologies: Empirical



- Goodness of Fit (Overfitting)
  - Curve-fitting tools are notorious for fitting high-order polynomials to low-order phenomenon, such as for log and square-root functions, or even just simple linear equations that are slightly obscured by noise.
  - While by adding enough high-order terms, there can eventually be a fit, to some criteria, within the data domain of the exemplars, but as soon as the equations are used outside the range of the training exemplars the fit can be extremely bad

Technique Summary

	Handcode	Empirical	Models
Availability of	Expert/Model	Data	Model
Goodness of Fit	Varies	Overfit	As good as it gets
Combinatorics	Limited	Limited	Virtually unlimited
Reliability	Good	Limited	Best
Range of Scenarios	Considered scenarios	Scenarios in exemplar set	Limited only by # of elements in Model

Technicians & Engineers

- The empirical techniques are comparable to using technicians to diagnose equipment
  - Most all the time the technician immediately knows what is wrong – because he has seen it before in actual practice or in training
  - The balance of the time the technician struggles because he doesn't know how to diagnose from first principles
- An engineer can diagnose anything if he has a schematic and some time
  - He is well-versed in the first principles and in reasoning about models
- The downside to using engineers is that they must be kept on call and they do require some time to think about the problem
- FMD software performs essentially the same analysis that an engineer would perform
  - But it is practical to keep the FMD software online 24/7
  - It is able to perform the analysis in less than a second

Autonomous Vehicle Simulation (MDAS.ai)

Sridhar Lakshmanan
Department of Electrical & Computer Engineering
University of Michigan - Dearborn

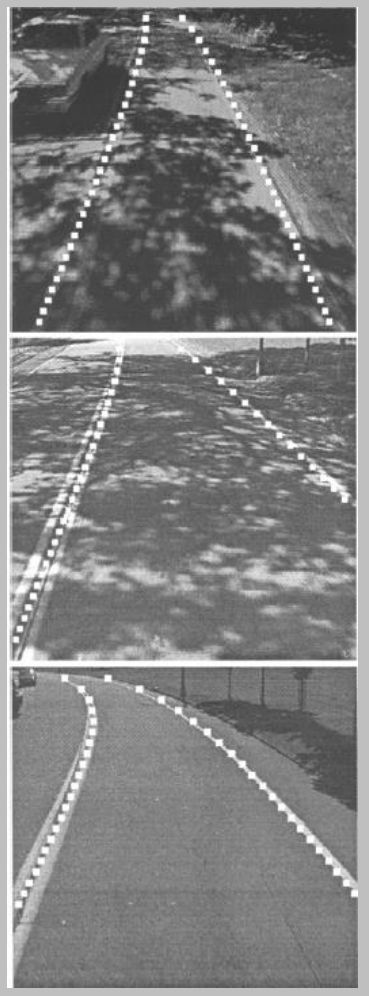
Presentation for Physical Systems Replication Panel –
NDIA Cyber-Enabled Emerging Technologies Symposium

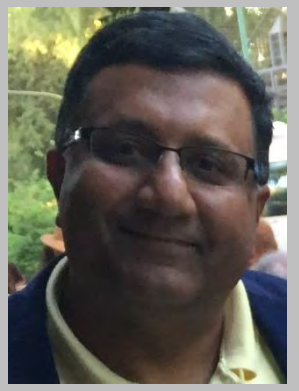
DEARBORN

Core Areas of Expertise

		Key words	Faculty Involved
AUTONOMY	Perception Big Data	Machine learning Bayesian Inference Sensor fusion	Sridhar Lakshmanan Yi Lu Murphey Paul Watta
AUTONOMY	Intelligent Control	Autonomous vehicles UAV Industrial robots	Stan Baek Yu Zheng Samir Rawashdeh Michael Putty
AUTONOMY	Vehicle Communications	v2v v2i v2p	Paul Richardson Weidong Xiang Chun-Hung Liu
AUTONOMY	Standards	SAE On-Road Automated Vehicle Systems (J3016) / Functional Safety (ISO 26262) RVSWG → 20 light and medium trucks standard	Steve Underwood Mark Zachos
AUTONOMY	Cybersecurity	Fingerprinting ECU's IDS	Hafiz Malik Di Ma
ELECTRONICS	Power Electronics	Solid state convertors Electric drives Charging	Kevin (Hua) Bai Maggie Wang Taehyung Kim Wencong Su
ELECTRONICS	Sensors & Chips	Chip Design / SOC Nano technology Solid state optics	Riadul Islam Alex Yi

Autonomous Navigation: Army ATD





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http://www.MDAS.ai

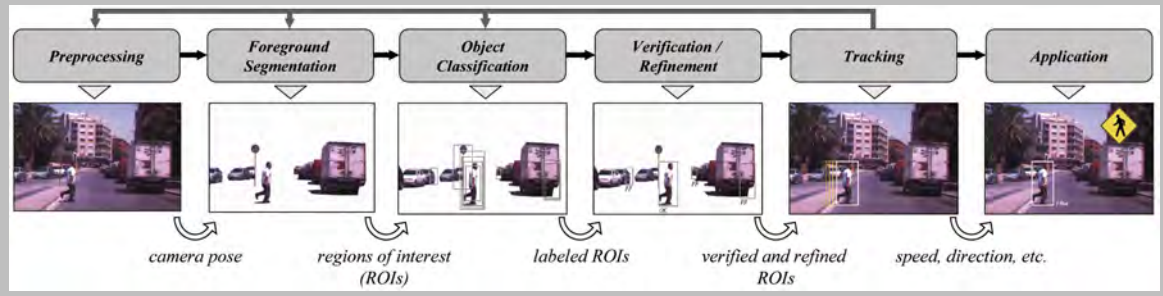
Miniature Robots: Army SBIR

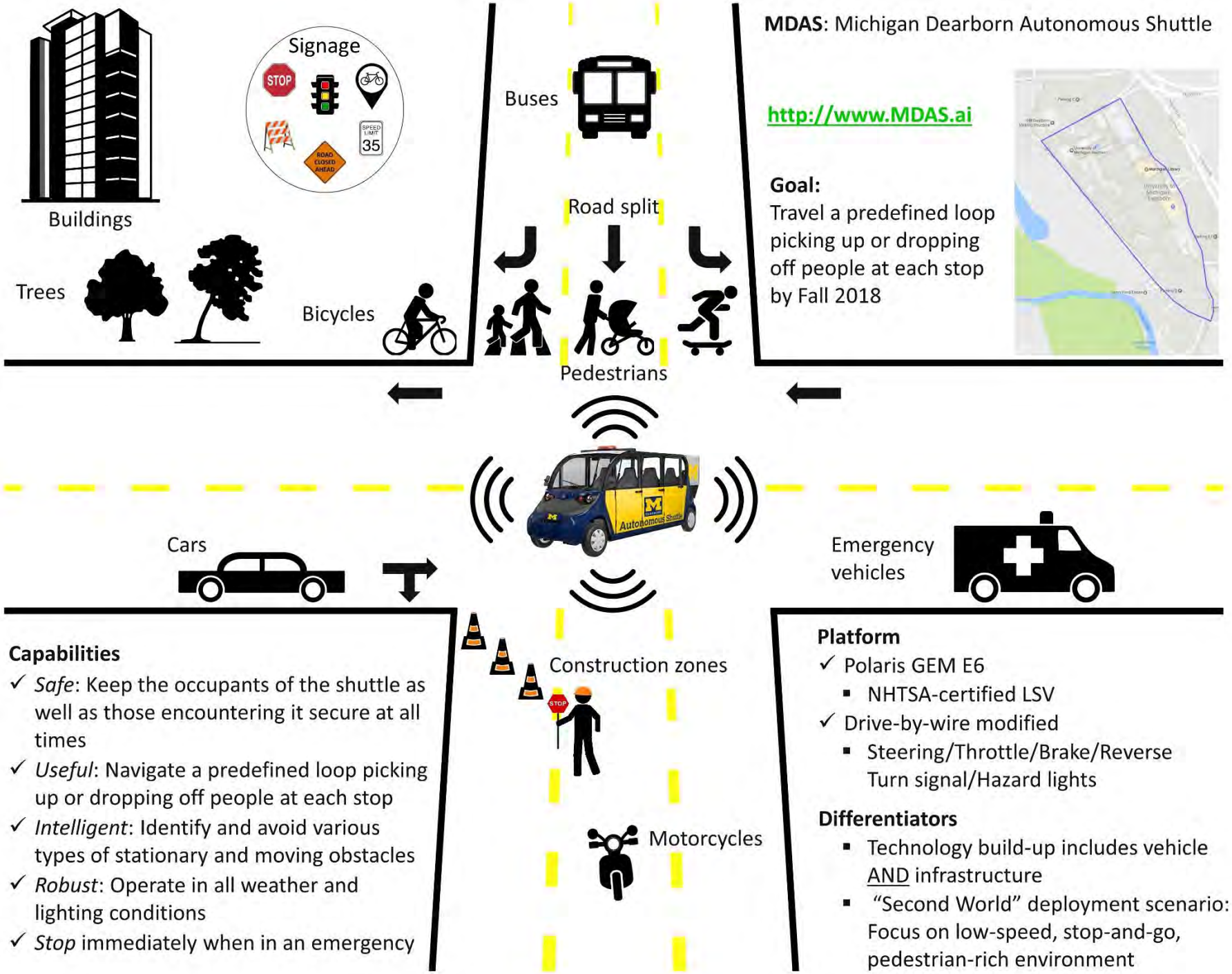
Sensor Fusion: DARPA

Lane Detection: Army

Driver Monitoring: NHTSA

Pedestrian Detection: Ford URP





MDAS: Michigan Dearborn Autonomous Shuttle

http://www.MDAS.ai

Goal:
Travel a predefined loop picking up or dropping off people at each stop by Fall 2018

Capabilities

- ✓ *Safe*: Keep the occupants of the shuttle as well as those encountering it secure at all times
- ✓ *Useful*: Navigate a predefined loop picking up or dropping off people at each stop
- ✓ *Intelligent*: Identify and avoid various types of stationary and moving obstacles
- ✓ *Robust*: Operate in all weather and lighting conditions
- ✓ *Stop* immediately when in an emergency

Platform

- ✓ Polaris GEM E6
  - NHTSA-certified LSV
- ✓ Drive-by-wire modified
  - Steering/Throttle/Brake/Reverse
    Turn signal/Hazard lights

Differentiators

- Technology build-up includes vehicle AND infrastructure
- "Second World" deployment scenario: Focus on low-speed, stop-and-go, pedestrian-rich environment

- ✓ Design, Build & Test
- ✓ Why simulate?
  - ➢ *Bring data back*
  - ➢ *Requirements*
  - ➢ *Failure modes*

DEARBORN

MDAS.ai Timeline & Ecosystem

Deep learning: Nvidia GPU

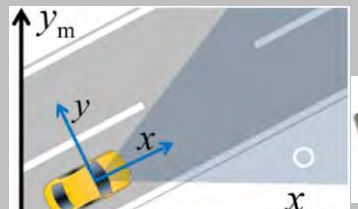
Fall ‘19: v2.0 Shuttle (Loop)

May ’19: AutoSens-D

Dec ’18: v1.0 Shuttle (Straightaway)

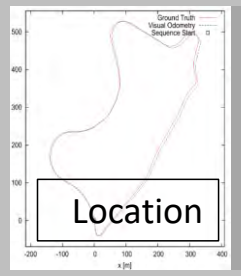
Aug ‘18: UMD-MEDC Showcase

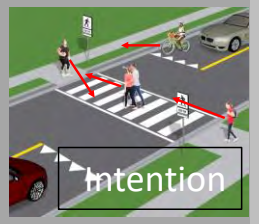
April ‘18: MI Robotics Day

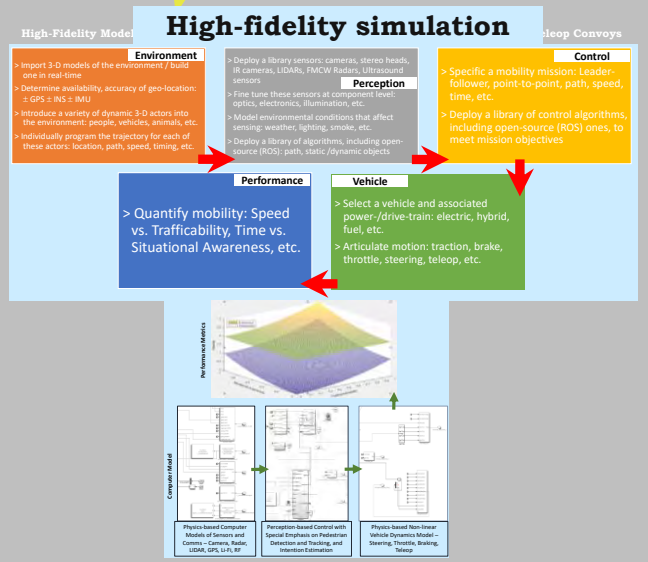


Localization
- Sub-cm accuracy
- GPS+

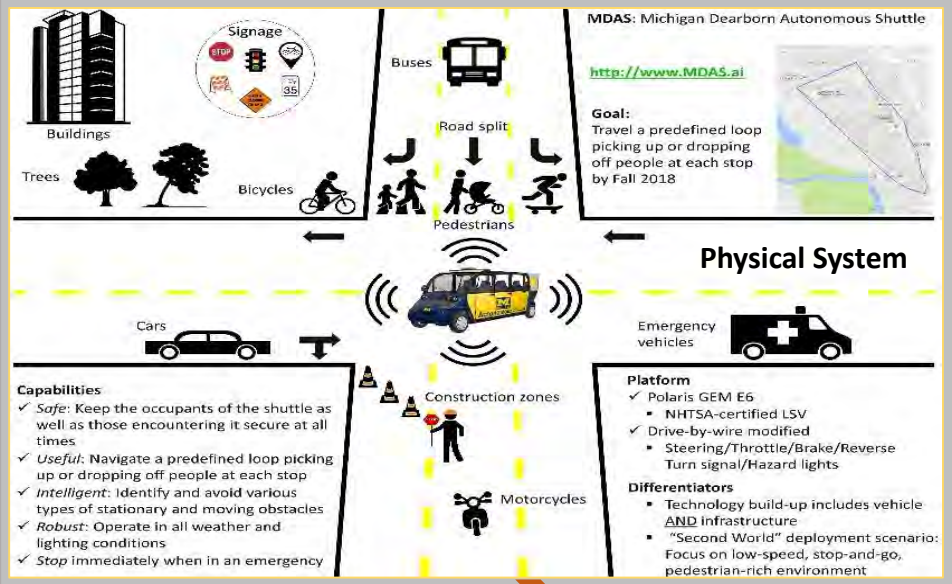
Drive-by-wire conversion
- Power-assisted steer
- Linear brake
- Analog throttle







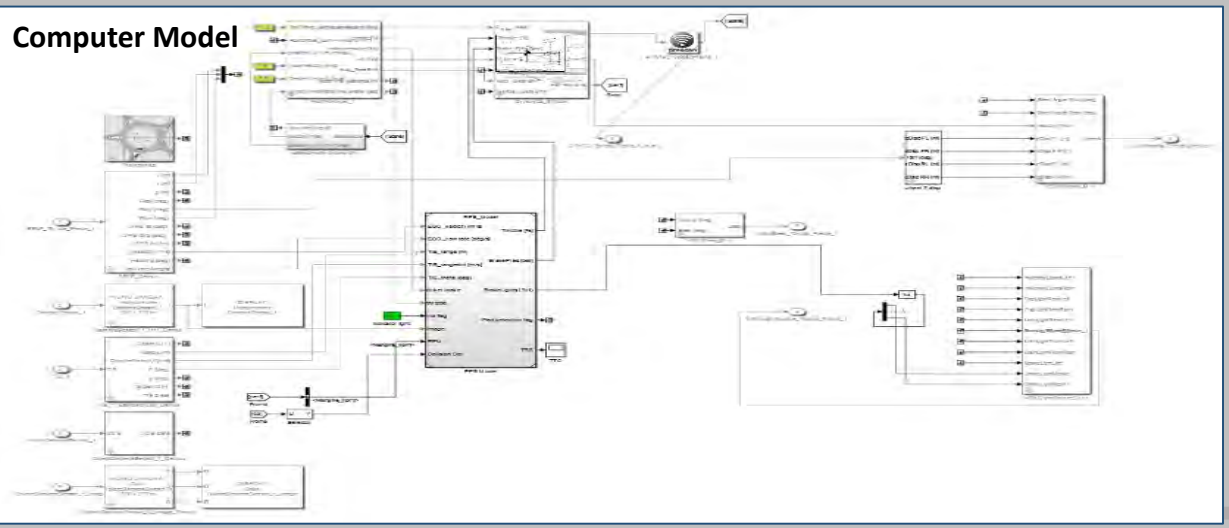
Mobility Model



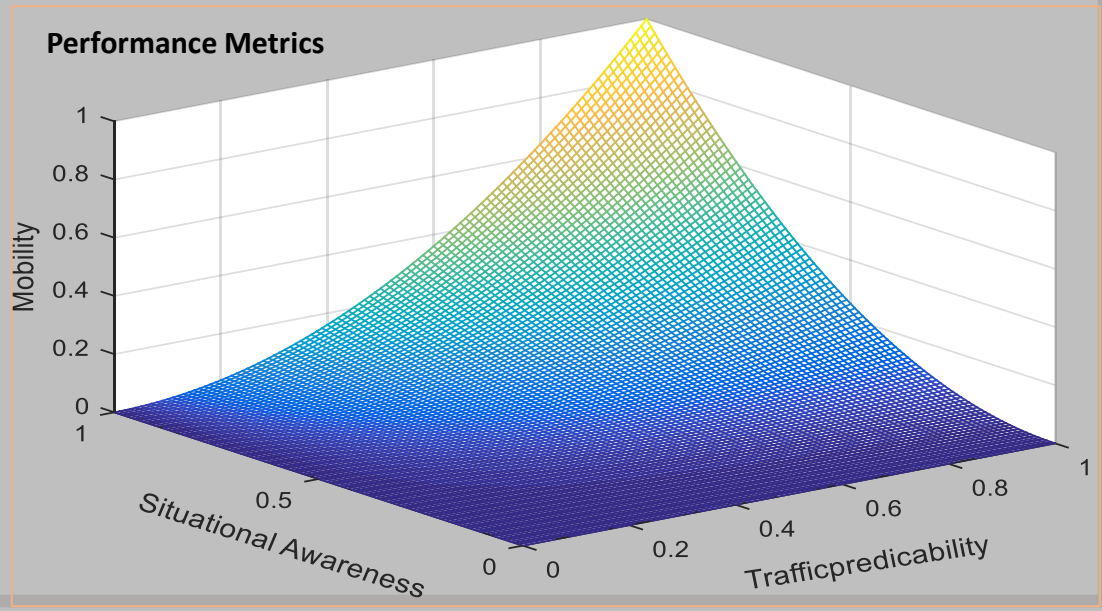
Capabilities

- Campus mobility model is Physics-based and not based on empirical data (see next sheet)
- Special case of the Next-Generation NATO Reference Mobility Model (NG-NRMM)
- Computer model is validated by real data from the physical shuttle MDAS.ai, and conversely, computer model is used to improve on-road performance of the vehicle
- Model output is performance metrics such as – Mobility, Traversability, Repeatability, Reliability
- Model used to:
  - ✓ Assess and compare autonomous systems in campus/urban environments
  - ✓ Compare autonomous systems to baseline human-driven systems
  - ✓ Benchmark progression of autonomous systems from Level-0 to Level-5
  - ✓ Assess performance of Perception Systems and Control Strategies

Computer Model



Performance Metrics



High-Fidelity Simulation: System of Systems of Systems

High-Fidelity Modeling and Simulation of Complex Pedestrian and Traffic for Supervised Teleop Convoys

Environment

> Import 3-D models of the environment / build one in real-time

> Determine availability, accuracy of geo-location: ± GPS ± INS ± IMU

> Introduce a variety of dynamic 3-D actors into the environment: people, vehicles, animals, etc.

> Individually program the trajectory for each of these actors: location, path, speed, timing, etc.

Perception

> Deploy a library sensors: cameras, stereo heads, IR cameras, LIDARs, FMCW Radars, Ultrasound sensors

> Fine tune these sensors at component level: optics, electronics, illumination, etc.

> Model environmental conditions that affect sensing: weather, lighting, smoke, etc.

> Deploy a library of algorithms, including open-source (ROS): path, static /dynamic objects

Control

> Specific a mobility mission: Leader-follower, point-to-point, path, speed, time, etc.

> Deploy a library of control algorithms, including open-source (ROS) ones, to meet mission objectives

Vehicle

> Select a vehicle and associated power-/drive-train: electric, hybrid, fuel, etc.

> Articulate motion: traction, brake, throttle, steering, teleop, etc.

Performance

> Quantify mobility: Speed vs. Trafficability, Time vs. Situational Awareness, etc.

ASK

SCORPION

When Failure is Not an Option

Cyber Garage and Visualization